#1

GRAVIMETRIC ANALYSIS OF HYPERHIDROSIS TREATMENT USING THE Nd:YAG 1440 nm LASER WITH A SIDEFIRING FIBRE SIDELAZE 800

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**Background:** Primary Focal Hyperhidrosis is a chronic disorder presenting as excessive underarm sweating. Quality of life can significantly decrease by impacting emotional well-being, social interactions and occupational duties. Current treatment methods for Primary Focal Hyperhidrosis are limited in duration and efficacy. The purpose of this case support study is to evaluate the efficacy and safety of a minimally invasive laser treatment using a delivery system for smaller anatomic areas. A 1440 nm Nd:YAG wavelength and a 800 μm sidefiring fiber inserted through a 150 mm handpiece was used.

**Study:** 13 patients (12 women and 1 man) with an average age of 31.4 years old, presenting a pretreatment 4 point Hyperhidrosis Disease Severity Score Scale (HDSS) score of 3 or greater, received a single treatment. Patients were seen at 3, 6, and 12 months follow-up. The amount of tumescent anesthesia in each axilla was 200 cc. The area treated, was divided into four 5 x 5 cm squares to determine amount of energy to be delivered, which resulted in an average of 6000 J/axilla. Gravimetric measurement, starch iodine test and pictures (digital image software analysis) were performed before, 3 and 6 months after the treatment.

**Results:** All patients reported an average HDSS improvement of 3.1 at follow up. Gravimetric measurements showed an improvement of 81.2%. Typical side effects like numbness, swelling, etc. were reported after treatment.

**Conclusion:** Minimally invasive treatment with a 1440 nm Nd:YAG laser, sidefiring fiber is an effective and safe option for the treatment of Primary Focal Axillary Hyperhidrosis. Additional follow up will be done to confirm long-term results after one and two years.

#2

EFFICACY OF A 1440 nm Nd:YAG LASER WITH A TARGETED ENERGY DELIVERY SYSTEM IN THE TREATMENT OF HYPERHIDROSIS

Bruce Katz, David Cangello

**Background:** Primary focal axillary hyperhidrosis is a chronic disorder of sweating of the axilla that creates significant impairment of an individual's daily activities. It is estimated that it affects over 1.4% of the U.S. population, a prevalence comparable to that of psoriasis.

**Study:** The purpose of this study was to determine the efficacy of a single laser treatment utilizing a new optical fiber to disrupt the glands located in the axilla. Efficacy was measured through both subjective and objective quantitative means. A total of 20 patients with moderate to severe hyperhidrosis of the axilla (HDSS scores of 3 and 4) were enrolled in this prospective IRB approved study. Subjects were treated in a single session with a 1440 nm pulsed Nd:YAG laser with a new fiber designed to deliver targeted energy. Patients were assessed at 3 and 6 months post treatment by a patient questionnaire (HDSS scores), physician evaluations, imaging software analysis of starch iodine tests as well as histologic studies.

**Results:** A total of 20 patients completed the study. Significant improvement was reported by patient evaluations and subjective physician assessments. The average HDSS score improved by 2 points. Imaging software analysis of starch iodine tests showed an average of 84% reduction in sweat area volume at three months and 99% at six months. Histologic studies demonstrated a reduction in both eccrine and apocrine glands. Minimal adverse effects were reported from patient diaries and physician assessments.

**Conclusion:** The 1440 nm Nd:YAG laser with targeted energy delivery fiber system is an effective tool in the treatment of axillary hyperhidrosis.

#3

MULTI-CENTER STUDY EXAMINING REDUCTION OF AXILLARY HAIR UTILIZING MICROWAVE TECHNOLOGY

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**Background:** Initial success utilizing microwave technology in the reduction of axillary hair has been observed in a single center trial after one treatment. We present an update with involvement of two additional centers and three month follow up data.

**Study:** Multi-center, prospective study of individuals with unwanted axillary hair growth. Subjects meeting all inclusion
TREATMENT OF KERATOSIS PILARIS WITH 810 nm DIODE LASER: A RANDOMIZED CONTROLLED TRIAL

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Background: Keratosis pilaris is a common condition of perifollicular prominence and erythema that can be resistant to treatment. There are reports of the use of vascular lasers, including 532 and 595 nm devices, but the therapeutic utility of longer-wavelength devices has not been studied.

Study: Placebo-controlled randomized control trial of adults with Fitzpatrick skin types I-III and previously diagnosed keratosis pilaris of the bilateral upper arms. For each subject, four treatments of 810 nm laser at settings just below the purpura threshold were delivered to one arm, and the other was left untreated. Subjects rated each arm before treatment and at the last follow-up on a 0–3 scale for erythema, and a separate 0–3 scale for roughness/bumpiness. Two blinded raters compared control and treatment sides at the final follow-up using the same two scales.

Results: Twenty-three subjects were enrolled, and 18 completed all study procedures and were analyzed. For subjects, improvement in redness from baseline did not differ significantly between treatment and control ($P = 0.1250$, Wilcoxon signed-rank test), but improvement from baseline in bumpiness was significant only for the treated sides ($P = 0.008$, Wilcoxon signed-rank test). Blinded dermatologists likewise did not observe significant differences in redness severity between control and treatment ($P = 0.109$, Wilcoxon signed-rank test), but did observe significant reductions in bumpiness severity ($P = 0.004$, Wilcoxon signed-rank test) and overall score ($P = 0.005$, Wilcoxon signed-rank test) on the treatment side compared to control.

Conclusion: Among lighter-skinned patients, serial treatment with long-pulsed 810 nm diode laser at subpurpuric levels can provide medium-term improvement in keratosis pilaris, particularly in the associated roughness and bumpiness.
Conclusion: adverse events were reported. Serious adverse events were reported. No treatment-related inflammation was observed. Changes in Global Acne Scores and sebumeter measurements were assessed. Global Acne Scores decreased at 60 and 180 days, respectively. 60% and 89% of subjects noted a "reduction in number of acne lesions" at days 60 and 180 respectively. No serious adverse events were reported. No treatment-related adverse events were reported.

Results: 23 subjects (26.1% male, 73.9% female) were treated. At interim analysis, 47% and 67% of subjects had a decrease in non-inflammatory lesions, 60% and 89% had a decrease in inflammatory lesions at days 60 and 180 days respectively, compared to baseline. 100% and 78% of subjects were satisfied or very satisfied with the results at 60 and 180 days, respectively. 70% and 66.7% of subjects noted "clearer skin" at days 60 and 180 respectively, compared to baseline. The average Global Acne Scores and average sebumeter measurements decreased at each time point compared to baseline. 60% and 89% of subjects noted a "reduction in number of acne lesions" at days 60 and 180 respectively. No serious adverse events were reported. No treatment-related adverse events were reported.

Conclusion: Interim Data from this pilot study suggests that MFU-V could be a promising novel treatment option for the reduction of acne lesions in subjects with moderate to severe combination inflammatory papulopustular and comedonal acne.

#7

TREATMENT OF ACNE WITH SELECTIVE PHOTOTHERMOLYSIS OF THE SEBACEOUS FOLLICLE WITH GOLD-COATED MICROPARTICLES, A CLINICAL STUDY

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Background: The development of energy based acne treatments has been constrained due to inadequate contrast provided by the infundibulosebaceous unit toward light and other energy sources. This clinical study explores selective delivery of exogenous chromophores, consisting of specially engineered microparticles with surface plasmon resonance for strong near-IR absorption, into the follicular units.

Study: Microparticles of 0.150 micron diameter consisting of inert gold surrounding a silica core, were constructed for strong absorption at 800 nm based on optical plasmon resonance. The treatment consisted of application of a microparticle suspension, gentle skin massage, superficial skin cleaning, and pulsed irradiation with an 800 nm laser. Previously, photothermal damage to sebaceous units has been reported in human postauricular skin with this method (ASLMS Annual Meeting, 2012, Kauvar et al.). An ethics committee-approved human study was conducted at two sites in Poland. In the randomized, two-arm study, subjects in the 'immediate treatment' arm (n = 22) were treated three times, with two week interval whereas in the 'delayed treatment' arm (n = 25), subjects used an OTC face wash, twice-a-day for 12 weeks. 33% were male with an average age of 21 years of age. The patients in the 'delayed-treatment' arm were crossed-over and began receiving treatments after 12 weeks observation. Inflammatory lesion counts were performed at baseline and at follow-up visits out to 28 weeks post baseline in both arms.

Results: At 12 weeks post baseline, in the treatment arm, the mean inflammatory lesion count change was –34% (n = 21) compared to –16% (n = 25) in the control arm (P = 0.03, statistically significant). The results continued to improve with longer follow-up. At 28 weeks post-baseline, the mean inflammatory lesion count change was –61% in the treatment arm. The mean inflammatory lesion count change in the cross-over arm showed similar decrease after cross-over (−54% after 28 weeks post-baseline). Patients were generally satisfied with the results and pain scores were low (average: 4) on a scale of 0–10.

Conclusion: Treatment consisting of externally delivered plasmonic microparticles, followed by pulsed laser irradiation, is capable of treating acne vulgaris. Change in mean inflammatory lesion counts at 28 weeks post treatment is –61%. This new treatment is an attractive and promising addition to the armamentarium of acne treatments.

#8

SELECTIVE PHOTOTHERMOLYSIS OF SEBACEOUS GLANDS FOR TREATMENT OF ACNE: EFFICIENT DELIVERY OF GOLD COATED MICROPARTICLES AS CHROMOPHORES INTO THE SEBACEOUS GLANDS WITH ULTRASOUND, A HUMAN HISTOLOGY STUDY

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Background: Selective photothermolysis of sebaceous glands for treatment of acne has been attempted via use of fat-selective wavelengths and other energy sources but has not been successful due to inadequate contrast provided by the glands. The desired contrast and high absorption of light by glands can be obtained by selective delivery of external chromophores to the glands. Gold coated microparticles designed for surface plasmon resonance at near-IR wavelengths provide an excellent contrast due to high absorption cross-section; the sub-micron size allows selective delivery through the infundibulum while preventing indiscriminate diffusion through the stratum corneum and their inert nature and long history support safe use in vitro. Ultrasound has traditionally been used to enhance delivery of small molecules through the stratum corneum. In this work, it is extended to deliver the gold microparticles selectively into the follicular units. The delivery is facilitated by high velocity microjets directed
toward the skin surface originating from collapse of cavitation bubbles near the skin surface.

**Study:** 37 subjects received delivery of microparticles utilizing ultrasound assistance in an IRB approved, single-site study in which delivery was performed on bilateral pre-auricular skin, followed by pulsed laser treatment with an 800 nm diode laser system. The ultrasound delivery method consisted of an ultrasound horn vibrating at 40 kHz immersed in a microparticle suspension placed in an enclosure above skin. 74 punch biopsies of treated skin were taken within 15 minutes of the treatment and fixed in 10% buffered formalin solution. These were processed histologically (H&E stain) and observed with an optical microscope.

**Results:** Treatment was well tolerated and clinical observations included focal peri-follicular erythema and edema. Histological analysis of serial sections showed specific destruction of the pilosebaceous units with no collateral damage to tissue surrounding the unit or to the epidermis.

**Conclusion:** Ultrasound assisted delivery allows for highly selective delivery of microparticles and through thermal damage to the infundibulosebaceous unit with no collateral damage and provides an effective means of follicular delivery of microparticles. This has the potential becoming a highly effective device based therapy rivaling systemic treatments targeting the sebaceous glands but without the side-effects common with non-selective treatments.

**#9**

**LONG-TERM REDUCTION OF ADULT ACNE USING EXCLUSIVELY 1064 nm LASERS FOR THERAPY**

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**Background:** Acne is a common skin condition affecting adults. It is a multifactorial condition that involves the pilosebaceous unit. Although laser and light sources have been shown to be effective in the treatment of acne, persistent improvement has been hard to maintain without the use of adjuvant therapy.

**Study:** Eleven patients with a diagnosis of moderate to severe inflammatory acne who had failed or poorly responded to topical and oral treatment regiments were treated with a long pulsed 1064 nm laser followed immediately by a Q-switched 1064 nm laser. Fitzpatrick Skin Types included I–V. Exclusion criteria included pregnancy, oral antibiotics, photosensitizing drugs, oral isotretinoin within 6 months prior to treatment. Patients were instructed to discontinue all forms of topical acne treatments two weeks prior to start of treatments. Clinical evaluations were performed by two blinded dermatologist using baseline and post-clinical photographs. Each subject was evaluated at two stages. First stage was baseline photographs compared to photographs taken after a series of treatments performed 2–4 weeks apart. Second evaluation was 13–78 weeks after the completion of laser therapy. Improvement scale was based on a level of 0–100.

**Results:** Subjects had a 78% reduction of acne at the first evaluation. No treatments were performed between the first and second evaluation. Subjects continued exhibiting an 84% reduction in acne lesions compared to baseline off all acne therapy. No adverse effects were noted and the treatments were well tolerated.

**Conclusion:** The combination use of long pulse and Q-switched Nd:YAG lasers is effective in achieving persistent results in treatment of resistant acne without the use of any other adjuvant therapy.

**#11**

**A RANDOMIZED CONTROLLED TRIAL TO ASSESS THE EFFICACY OF A NEEDLING DEVICE FOR THE TREATMENT OF ACNE SCARS**

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**Background:** Neocollagenesis can be achieved using a dermal, rolling needle device, therefore, reducing the appearance of acne scars. The purpose of this study was to assess the efficacy of the needling device for treatment of acne scars.

**Study:** Single-center, rater-blinded, balanced (1:1), split-face, placebo-controlled, parallel-group randomized control trial at an urban, academic institution. Healthy adult volunteers, ages 20–65, with acne scars on both sides of the face were enrolled. For each subject, one side of the face was randomized for needling. 3 treatments of needling were performed at 2 week intervals. Two blinded dermatologist separately rated subjects’ acne scars based on standard digital photographs obtained at baseline, and 3-month and 6-month follow-up visits on the quantitative global scar rating grading system.

**Results:** 20 subjects were enrolled, and 15 completed all study procedures and were analyzed. Mean scar scores were significantly lower in the treatment group compared to baseline at 6 months ($P = 0.029$) and approached significance compared to baseline at 3 months ($P = 0.052$). In the control group, mean scar scores did not vary significantly over time ($P > 0.80$). The needling procedure was not particularly painful with the mean pain rating 1.08 out of 10. Subjects perceived a 41% mean improvement in overall scar appearance on the treated side. No adverse events were reported.

**Conclusion:** After 3 treatments of needling, there was some improvement in the appearance of acne scars over time compared to control group, with minimal pain reported.

**#12**

**DIFFRACTIVE LENS ARRAY WITH PICOSECOND LASER FOR FACIAL ACNE SCARRING: FOLLOW UP AND HISTOLOGY**

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**Background:** Lasers are routinely utilized in the treatment of acne scarring, with thermal injury resulting in collagen synthesis and remodeling. Use of a diffractive lens array and picosecond laser has previously demonstrated improvement with minimal preparation and downtime. We present complete clinical and 3-D imaging analysis, as well as new histologic findings.

**Study:** Single-center study of 20 subjects with facial acne scarring. Subjects received six treatments with a 755 nm
This study examines the safety and efficacy (outcomes) by such as punch excision and subscision, abrasion and laser skin resurfacing for superficial type scars, sequella. Recommended therapies include mechanical derm.

Patients were enrolled. Blinded assessment of photography of 17 subjects was performed, with average scores of 1.5/3 and 1.4/3 at one and three months, respectively (0: 0–25%, 3: >75% improvement).

Analysis of 3-dimensional data yielded an average of 24.3% improvement in scar volume, maintained at one (24.0%) and three (27.2%) months after treatment. Histology of all follow-up specimens revealed elongation and increased density of elastic fibers, with an increase in dermal collagen and mucin.

Conclusion: Treatment of facial acne scars with a diffractive lens array and 755 nm picosecond laser demonstrated maintained improvement in appearance and texture at three months after last treatment, with objective findings similar to those published for a series of fractional ablative laser treatments. Furthermore, histology revealed persistent changes in elastic fibers, and mucin, suggesting that improvement in scarring from this treatment is the result of dermal changes beyond remodeling of collagen.

#13

EVALUATION OF A UNIQUE SIDE FIRING 1440 nm FIBER LASER FOR ACNE SCARRING

Richard Gentile
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Background: Acne is one of the most commonly treated dermatological conditions and persistent visible scarring can be a sequella. Recommended therapies include mechanical dermabrasion and laser skin resurfacing for superficial type scars, while surgical approaches are suggested for deeper type scars, such as punch excision and subcision.

Study: This study examines the safety and efficacy (outcomes) by subdermal treatment with a highly targeted laser optical fiber delivery method which includes a thermal subcision of fibrotic connective tissue and thermal stimulation of subdermal skin temperature to induce neocollogenesis resulting in remodeling of the upper skin surface. The study evaluated 20 subjects with acne scarring some with active acne as well. The ECCA grading scale was used for diagnosis of scars and their severity. Each patient was given a single treatment with the 1440 nm wavelength laser equipped with a unique side-firing fiber and temperature monitoring device with an average of 1182 J/cm² delivered per each side of the face. Each subject presented for follow-up at 3 and 6 months post treatment. High resolution photographs and satisfaction surveys were taken before treatment and at follow-up visits. The investigator graded each patient through high resolution digital photography before and after treatment and a patient satisfaction survey was taken.

Results: Patient satisfaction was high with all subjects reporting satisfied or extremely satisfied. The average ECCA score demonstrated a 41.1% improvement to all scars with t-test indicating a statistically significant change. According to patient surveys, 89% of patients reported smoother skin texture. Improvement to superficial elastolysis demonstrated the highest improvement category with a 58% improvement based on ECCA scale. A significant reduction was also noted with those patients with active acne.

Conclusion: The 1440 wavelength laser with side-firing fiber for subdermal treatment of acne scars is a safe and effective modality to improve the condition of acne scars.

#14

PROJECT HEAL: FRACTIONAL RESURFACING FOR VICTIMS OF THE BOSTON MARATHON BOMBING

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Background: Those affected by the Boston Marathon Bombing will have permanent scarring and disfigurement that will affect their lives in a multitude of ways. We reached out to the blast victims to offer no-cost services to improve the clinical appearance of scars and lessen any physical impairment with which they now live. The use of fractional ablative resurfacing, pulsed-dye laser, and Q-switched lasers has been well reported in treatment of Wounded Warriors, and due to similarity in wound patterns, we approached management in a comparable manner.

Study: Patients presented with scars from graft donor-sites, muscle flap reconstructions, wounds healing by secondary intent, contractions, and blast injury/foreign body traumatic tattoos. Treatments included the pulsed-dye laser to reduce erythema and improve texture, Q-switched lasers to improve appearance of traumatic tattoos, intraleansional corticosteroids to decrease bulkiness, and various ablative fractional CO2 lasers for texture and mobility. The settings for the fractional lasers ranged from low density and high fluence with the goal of releasing scar contraction and improving pliability, to moderate density and fluence, in an attempt to flatten scars and provide cosmesis. After some, a mixture of 5-flurouracil and intraleansional corticosteroid was drizzled over the treatment area.

Results: Results have been encouraging and include decreased erythema, more uniform texture, increased suppleness, decreased thickness of scars and improved functionality.

Conclusion: These treatments have provided the victims of the Boston Marathon Bombing, as those in the Wounded Warriors Project, relatively non-invasive means to ameliorate their cutaneous functional and cosmetic deficits. Pulsed-dye and Q-switched devices can be utilized to improve scar color and pigment; and fractional ablative lasers can enhance texture, skin contracture and pliability.

#15

NON-ABLATIVE FRACTIONAL LASER TREATMENT FOR EARLY INTERVENTION OF TOTAL KNEE REPLACEMENT SCARS-PILOT STUDY

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Background: As demand for total knee replacement (TKR) increases concern regarding wound healing of TKR scars has risen. Non-ablative treatments with 1540 nm fractional laser devices can improve the cosmetic appearance of non-traumatic scars, but there is minimal reported experience with surgical
Laser therapy can be safely applied to TKR wounds and may aid treatment in reducing pain, stiffness, and functional limitation. Group A WOMAC scores were higher, suggesting that laser analysis of the WOMAC scores was performed.

Background:

Despite precise surgical technique, some postoperative facial scars will depress and widen over time, likely due to weakened or inadequately replaced collagen fibers in the underlying dermis. The purpose of this study is to demonstrate the use of a 10,600 nm ablative carbon dioxide (CO2) fractional laser early in the post-surgical setting can result in improved postoperative facial scars after a single treatment session.

Study: A prospective, randomized, comparative split-scar study was conducted on 24 subjects between the ages of 20–90. Subjects underwent Mohs surgery for non-melanoma skin cancer of the face. Subsequent to tumor removal, subjects with a symmetric linear scar of 4 cm or greater were enrolled. On the day of suture removal, all subjects had one half of their scar randomly selected and treated with a 10,600 nm CO2 fractional laser (energy = 10 mJ; density = 10%; spot size = 7 mm; pulse = 1). The untreated scar half served as a control. Scars were re-evaluated 12 weeks later. An independent blinded observer graded the scar-halves with the Vancouver scar scale (VSS) immediately prior to treatment and 12 weeks after treatment. Subjects completed a visual analog scale (VAS) at the same time points.

Results: 21 out of 24 subjects are enrolled at the present time, with 15 subjects having complete data entry. Currently, there is a trend to improvement of the overall changes in VSS (P = 0.21) and VSS scar height (P = 0.13). There are statistically significant differences in VSS pliability (P = 0.047) and patient VAS (P = 0.007).

Conclusion: Subjective improvements with early fractional CO2 lasing of surgical scars is evident. An objective improvement in scar pliability also occurs, though other parameters of the VSS do not currently reveal a statistically significant difference. Conservative laser settings, a single session treatment, and VSS insensitivity for surgical scars may influence these data.

#17

USE OF THE 10,600 nm CARBON DIOXIDE FRACTIONAL LASER ON SURGICAL SCARS FOLLOWING MOHS MICROGRAPHIC SURGERY

Joseph Sobanko, Vasanop Vachiramon, Pinyo Rattanaumpawan, Christopher Miller

University of Pennsylvania, Philadelphia, PA; Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Background: Despite precise surgical technique, some postoperative facial scars will depress and widen over time, likely due to weakened or inadequately replaced collagen fibers in the underlying dermis. The purpose of this study is to demonstrate the use of a 10,600 nm ablative carbon dioxide (CO2) fractional laser early in the post-surgical setting can result in improved postoperative facial scars after a single treatment session.

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Conclusion: Subjective improvements with early fractional CO2 lasing of surgical scars is evident. An objective improvement in scar pliability also occurs, though other parameters of the VSS do not currently reveal a statistically significant difference. Conservative laser settings, a single session treatment, and VSS insensitivity for surgical scars may influence these data.

#18

TREATMENT OF HYPERTROPHIC BURN SCARS WITH DIFFERENT LASER MODALITIES

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Background: Prospective, controlled studies that evaluate the effectiveness of laser light of various wavelengths on hypertrophic scars are scarce. We have conducted 3 prospective controlled trials with different lasers on hypertrophic burn scars over the last several years: KTP at 532 nm, Erbium-Glass (Erb-Glass) at 1550 nm and fractional CO$_2$ (fxCO$_2$) at 10600 nm. This presentation will compare our findings from all three studies and we are suggesting a treatment guideline based on the collected evidence.

Study: The study design for all three studies was prospective, intra-individually controlled, measuring objective and subjective scar qualities before and after a treatment series with the three different lasers. All subjects were burn survivors and had at least two scars of similar appearance and physiologic function in the same body area. All treatment scars were treated with the respective laser under local anesthesia for a minimum series of 3 treatments, at least 4 weeks apart. All scars were at least 6 months post wound healing.

Results: 66 patients, 43 male, 23 female, mean age of 40, with 141 scars were included into the three studies. 54 were Caucasian, 7 African American, 3 Asian and 2 Hispanic. There was no adverse effect in the 532 KTP or fractional CO$_2$ laser study, one blister formation in the Erb-Glass laser study. Objective measurements were as follows: Elasticity (Cutometer®) Treatment (Fx) better at 0.32 for KTP, 0.3 for Erb-Glass and 0.48 for fxCO$_2$. Pigment (Spectrometry) no difference pre-post for KTP and Erb-Glass, 0.001 better for fxCO$_2$. Erythema (Spectrometry) 0.004 better for fxCO$_2$. Sensation (Semmes-Weinstein) better 0.009 for KTP, 0.33 for Erb-Glass and 0.001 for fxCO$_2$. Thickness (high resolution ultrasound) no change for KTP, better 0.004 for Erb-Glass and <0.001 for fxCO$_2$. Subjective scar scales were as follows: Vancouver Scar scale (independent evaluator) better 0.017 for KTP, 0.001 for Erb-Glass, 0.009 for fxCO$_2$. Patient subjective scar scale better 0.002 for KTP, 0.001 for Erb-Glass and 0.012 for fxCO$_2$. Pruritus and pain no difference in any of the studies.

Conclusion: All laser treatments improved the scars somewhat compared to the control scars. While minimal effects were seen with the KTP laser, treatments with the fractional CO$_2$ laser showed statistically significant improvements in the objectively measured scar qualities thickness, elasticity, sensation, pigmentation and erythema. Our standard treatment regimen for hypertrophic burn scars now includes the non-ablational Erbium-Glass laser for early scars (within 3 months), followed by fractional CO$_2$ laser treatments to achieve a thinner, more pliable, more evenly pigmented scar.

#19

COMPARISON OF 1550 nm FRACTIONAL LASER ALONE vs FRACTIONAL LASER PLUS INTENSE FOCUSED ULTRASOUND FOR TREATMENT OF STRIAE DISTENSAE

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Background: Treatment of striae (stretch marks) remains a challenging therapeutic goal. Fractional non-ablative laser devices are frequently for this purpose, and it has been suggested that concurrent use of radiofrequency or ultrasound skin tightening devices may improve overall response. Study: A randomized controlled trial comparing treatment of thigh or abdomen mature (white) striae with either: (1) 4 treatments 2 weeks apart of 1550 nm fractional laser; or (2) 4 alternating treatments, 2 weeks apart, of 1550 nm fractional laser and intense focused ultrasound. For each patient, either thighs or abdomen were treated. In each case two 10 x 10 cm affected areas were identified on contralateral sides, and each of these subdivided into treatment and no treatment areas: random assignment was used to determine which major area received each treatment type, and which half of each treatment area was the control.

Results: A total of 30 patients were enrolled, and 22 completed all study procedures and were analyzed. Forced agreement of two blinded live raters indicated that both fractional laser alone, and fractional laser plus ultrasound, provided improvement from baseline, with 18/22 of each being superior to controls (binomial analysis, $P = 0.0043$). In direct comparison, fractional laser alone was deemed to be superior to laser plus ultrasound ($P = 0.0169$), but there were no subgroup differences on the specific parameters of roughness, wrinkles, dyschromia, or shiny appearance. Measurements of scar width did not differ significantly between treatments or over time (mixed ANOVA, $P = 0.7181$).

Conclusion: Both fractional laser treatments alone, and alternating treatments of fractional non-ablative laser and intense focused ultrasound, can improve the appearance of striae. There appears to be a greater overall benefit from fractional laser treatment, but specific features are not more improved. More research is needed to optimize treatment of striae, and to see if any other combination of fractional laser and ultrasound may provide superior results.

#20

COMBINED FRACTIONAL CO$_2$ LASER AND Nd: YAG LASER IN TREATMENT OF STRIAE DISTENSÆ: A CLINICAL AND HISTOPATHOLOGICAL STUDY

Eman Sharaawy, Dalia Abdel Halim, Yosra Abdel Galeil

Cairo, Egypt

Background: Although a variety of treatment modalities have been attempted for striae distensæ (SD), as topical therapy, mechanical stimulation, thermal stimulation, dermabration, microdermabrasion, platelet rich plasma and laser therapy, no definite ‘gold standard’ treatment modality has been determined. Purpose: To compare the efficacy of fractional CO$_2$ laser versus that of combined fractional CO$_2$ laser and Nd:YAG laser in treatment of striae distensæ.

Study: The study was a randomized comparative study, It included twenty female patients; ten with striae rubra and ten with striae alba. Full detailed history was obtained; thorough clinical and dermatological examination was done. Four laser sessions, one month apart, were given for each patient. The right side was treated with Fractional CO$_2$ laser 10,600 while the left side was treated using combined fractional CO$_2$ laser and 1,064 nm Nd:YAG laser. A 3–5 mm punch biopsy was taken before treatment & one month after 4 laser sessions from each side, the biopsies were stained with Masson trichrome stain for evaluation of the change in collagen thickness.

Results: A statistically significant improvement was noted clinically regarding the size, the color, the appearance and histologically regarding improvement in collagen remodelling in both types of SD with both types of laser, with better improvement obtained in the striae rubra group ($P < 0.001$).

Conclusion: Fractional photothermolysis via Fractional CO$_2$ laser and long-pulsed 1,064 nm Nd:YAG laser are effective and
safe methods for treatment of striae distensae in patients with skin types III:IV with minimal side effects.

#21

CO2 FRACTIONAL LASER: OBJECTIVE 6 MONTH FOLLOW UP USING HIGH RESOLUTION ULTRASOUND IMAGING AND CUTOMETRY

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Background: The object of our study was to provide an objective follow-up of CO2 fractional laser treatment on a 6 months period.

Study: The laser used was the SmartXide Dot (Deka, Italy) with the following parameters: 30 w, 500 μm, 1 ms. High resolution ultrasonography measured the dermis thickness and the solar elastose (SENEB). Cutometer calculated the elasticity, viscosity and fatigability of the skin. The statistical analysis was carried out by the investigation centre of Tours University. An evaluation was done prior to treatment then after 1 month, 3 months and 6 months after the end of the treatment.

Results: 24 patients took part in the study. The dermis thickness increased continuously between the 1st and the 6th month. The thickness of the SENEB remained unchanged. There was no better result for patient who received two sessions nor for those with heavier postoperative recoveries. But there was better result for those with a thinner, younger skin, on certain areas and finally with smokers. The cutometric parameters of viscosity and fatigability decreased continuously over the 6 months period. On the other hand the elasticity parameters after a slight increase in the first month, did decreased continuously over the rest of the period.

Conclusion: The effect of the fractional CO2 laser increased over time over the 6 month period, unlike other cosmetic procedures like fillers and “botox” whose effects wear out on the same period. Two further surprising factors have to be mentioned: the positive effect of smoking and the fact that a second treatment produces not further significant remodeling effect. The cutometric analysis shows the incidence of the laser on the viscosity which could in fact amount to a gain of firmness; the temporary loss of elasticity was surprising but can be explained by the fibroing effect of the laser.

#22

PROSPECTIVE PILOT EVALUATION OF A NOVEL UNIPOLAR FRACTIONAL ABLATIVE RADIOFREQUENCY DEVICE WITH DERMAL ROLLING MECHANISM IN FITZPATRICK SKIN TYPES III - V

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Background: There is increasing diversification of patients seeking non-surgical rejuvenation, and development of devices to address this need. Appropriate use in pigmented skin of radio-frequency (RF) devices has good efficacy and safety in pigmented skin due to these devices’ lack of chromophore specificity and relative epidermal sparing. This pilot evaluation investigated efficacy, tolerability and safety of a novel, FDA-approved fractional ablative RF device.

Study: 20 healthy patients with skin types III to V were evaluated prospectively after appropriate washout periods for procedures including laser/light, fillers, toxins, chemical peels, and surgery. Pre-treatment assessment included 5 point scoring for fine lines and wrinkles, skin color/tone, skin tightness, and pore prominence; and standardized digital 3D imaging. Patients received 3 treatments at 3–4 weekly intervals with a unipolar fractional ablative RF roller device at 40.68 MHz and up to 80 W. The device has 6 cogs with 50 micro-electrodes on each cog. When rolled over the skin, they produce multiple micro- ablative thermal conduits across the epidermal-dermal junction. Full face treatment was performed with 2 perpendicular passes. Evaluations at 1 week and 3–4 weeks after each treatment included 5 point scoring for fine lines and wrinkles, skin tightness, pore prominence and skin color/tone; scoring on the validated Global Aesthetic Improvement Scale (GAIS); and standardized 3D imaging. Tolerability evaluation included assessment of post-treatment erythema. After 3 treatments, the same evaluations occurred during 2 or more follow up visits at 3–4 weekly intervals. Patient questionnaires evaluated perception of improvement in the specific parameters and satisfaction with treatment.

Results: All patients had significant improvement, with skin tightness, brightness and color/tone most improved and fine lines and rhytids markedly improved for those patients who had them at baseline. All patients scored 1 (Improved) or greater on the GAIS, and reported themselves Satisfied or Very Satisfied. Treatment was well tolerated and there were no significant adverse events.

Conclusion: Fractional ablative unipolar RF roller technology was found to be safe, efficacious and well tolerated for pigmented skin. Larger, controlled studies would increase the evidence level. Pilot evaluation suggests comparable results but decreased discomfort and shorter recovery than with conventional fractionated lasers. Extended evaluation to assess longevity of results is in process.

#23

COMBINATION IPL AND NON-ABLATIVE FRACTIONAL MICRO-COMPRESSION OPTICS FOR SKIN REJUVENATION

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Background: The use of optical mechanical coupling with point compression of optical prongs has demonstrated that energy may be delivered as deeply as 2000 microns in experimental models. The purpose of this study was to determine if clinical outcomes for photoaging were improved by combining 1540 nm fractional non-ablative zones with more superficial IPL for pigmentation, wrinkles and texture.

Study: Treatments from 2011 to 2013 were reviewed and patients (N = 25) treated using a fractional 1540 nm handpiece with a micro-compression optical tip plus treatment with IPL were selected. Treatments included IPL using the Max G head (Icon platform, Palomar Medical) immediately followed by using a square array with 49 micro-pins each co-aligned with a micro-beam and separated by 2 mm. The IPL portion delivered dual-band spectral output including 500–670 nm and NIR Bands of Hb (870–1200 nm). The total number of treatments was recorded as well as any side effects, comments regarding pain during the procedure and efficacy assessment performed via clinical images.

Results: The median number of treatment was 2. No topical anesthesia was employed, air cooling was utilized in 82% for added comfort. No epidermal injuries were reported. Treatments consisted of 1 pass with IPL and 2 passes of 1540 nm using 50 mJ per fractional beam, pulse duration of 15 msec. Ninety percent of
patients rated their skin as clinically improved. Minimal crusting of pigmented areas was noted for most patients at 48 hours but diminished by 72 hours.

**Conclusion:** Combination of IPL and micro-compression fractional array results in a clinical significant improvement in photoaging. The treatment is safe and may accelerate outcomes vs. either modality used alone as clinically significant improvement was noted by the majority of patients with only 2 treatments.

#25

**ASSOCIATION OF TECHNIQUES (4T) FOR FACIAL REJUVENATION**

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**Background:** The use of associated and less invasive techniques can be an alternative for cutaneous rejuvenation. The objective of this study is show the safety and efficacy of the 4T treatment, associating polymethyl methacrylate-based fillers with fractional CO2 laser, radiofrequency and the botulinum toxin simultaneously.

**Study:** This is a retrospective study of patients who had undergone a treatment with four different rejuvenation techniques, applied simultaneously. We have analyzed more than 1400 patients, who had been submitted to a rejuvenation treatment, associating polymethyl methacrylate fillers with fractional CO2 laser, radiofrequency and the botulinum toxin simultaneously, in the period between December 2009 and July 2012.

**Results:** There haven’t been complications associated to the combination of these four techniques. The results have been encouraging, once they showed safety and efficacy, as well as a high level of satisfaction among the patients.

**Conclusion:** The 4T treatment has demonstrated to be safe and efficient, with satisfactory results for the patients, offering a recovery period similar to that of the use of fractional CO2 laser individually, presenting, however, complementary and synergistic effects.

#26

**EFFECTS OF A NOVEL VITAMIN C DERIVATIVE GO-VC, AFTER TREATMENT OF FRACTIONAL CO2 LASER IN ASIAN PATIENTS**

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**Background:** Fractional CO2 laser resurfacing uses light energy to treat certain skin conditions, such as scars and photo aging, by stimulating collagen and elastin fiber production in the dermis but it is possible that the CO2 ablation causes noticeable adverse effects such as erythema for Asian skin. For preventing for adverse effect, we have been investigated the combination effect of laser and topical treatment of an anti-oxidant such as vitamin C. Previous studies have shown that application of vitamin C improves wound healing and promotes the induction of collagen. The objective of this study was to prospectively evaluate the efficacy of vitamin C decreasing post-laser treatment downtime.

As a new nonionic and amphiphilic ascorbic-acid derivative, g2-glyceryl-3-octyl ascorbateh (GO-VC), which is synthesized by introducing an octyl and a glyceryl groups into ascorbic acid structure, is recently developed. Although vitamin C has a low skin-penetration ability because of water solubility, GO-VC has an amphiphilicity and is expected to have a high skin-penetration ability. Due to its unique chemical structure, in addition to the effects of AsA, GO-VC is expected to have a humectant effect derived from glycerin and an anti-bacterial property derived from octanol, and also is highly likely to have an acne, spot and wrinkle improving effects.

**Study:** The skin was pre-treated with a fractional CO2 laser. After the laser treatment, to clarify improvement effect of GO-VC against acne, pigment spot and wrinkle, we investigated effects of GO-VC on dermal matrix reconstruction and a melanogenesis-suppression. Furthermore, we investigated the possible beautiful-skin realizing effect of GO-VC by clinical trial. In the assay of dermal matrix reconstruction, we focused on proriferation and collagen production of normal human dermal fibroblasts (NHDF). After cultuvation in DMEM containing 10, 30, 100, and 300 fEmol/L GO-VC for 48 h under a 5%-CO2 condition at 37 °C, the proliferation rates of the NFDFs were evaluated by 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay. In the assay of collagen production, the amount of collagen in medium of NHDFs which were cultured in DMEM containing 25, 50, 75 fEmol/L GO-VC for 24 h under a 5%-CO2 condition at 37 °C, were quantified with the ELISA method. In the assay of melanogenesis-suppression, we evaluated an effect of GO-VC on melanogenesis of mouse melanoma B16-4A5 cells (B16 cells). In the examination, we used 300 and 1,000 fEmol/L arbutin, 10 and 30 fEmol/L hydroquinone as positive controls. In addition, melanogenesis of B16 cells was stimulated with theophylline. After cultuvation with DMEM containing 10, 30, and 100 fEmol/L GO-VC, and, for 72 h under a 5%-CO2 condition at 37 °C, the B16 cells were solubilized with 1N NaOH. melanin contents of cells were determined by measurement of absorbance at 405 nm of the resulting solution. In clinical trial, male and female volunteers were asked to apply a gel product containing 0.05% GO-VC to their face after washing twice a day at morning and evening for 1–2 months. At the end of the trail, the situation of the face skin was evaluated by an automate skin-analyzer, Rob skin analyzer objectively.

**Results:** It was founded that GO-VC enhanced the proliferation of fibroblasts and collagen-production more significantly than the control. Moreover, GO-VC was found to suppress the melanin production dose-dependently, and the suppressing effect appeared at lower concentration than that of arbutin, which is a famous skin-whitening agent. Furthermore, without noticeable adverse effects, the numbers of pores, redness, spots and wrinkles were found to decrease. Adverse effects such as skin dryness, which were observed on the skin after treatments with other AsA derivatives, were remarkably improved by GO-VC.

**Conclusion:** These results suggest that GO-VC has a high beautiful-skin realizing effect and is expected to be effective as post-care after laser treatment. Overall vitamin C is well tolerated immediately post fractional ablative laser.

#27

**PICOSECOND LASER FOR REDUCTION OF WRINKLES**

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Background: Prospective study to evaluate the efficacy and safety of the treatment of wrinkles, including peri-oral and periorbital wrinkles using a lens array (fractional) picosecond 755 nm Alexandrite laser.

Study: The device utilized was a picosecond laser (Picosure, Cynosure, Westford, MA) with a lens array focused on the skin surface. Optimal treatment parameters were used compare severity of wrinkles using the Fitzpatrick Wrinkle Severity Scale (FWSS) pre-treatment and at 3 month follow up for 20 patients. Additional evaluation of histological data from biopsies in 2 patients was performed. Investigator and subject assessment were obtained to compare level of improvement using a global aesthetic improvement scale (GAIS). Recovery time and side effects were recorded.

Results: Reduction of wrinkles was seen on FWSS, with a median of 2 point improvement as assessed by blinded photograph assessment. Subject assessment showed a median satisfaction rating of 50–75% in concordance with physician assessment. Side effects included erythema and slight edema for 24–48 hours. Histology confirmed increase in dermal collagen compared to baseline.

Conclusion: Picosecond alexandrite laser delivered in a fractional lens array may be an effective method of treating wrinkles and photaging. Data indicates that patients appreciate a textural improvement with minimal side effects or downtime and with correlation to physician grading of images.

#28

FACELIFT COMBINED WITH SIMULTANEOUS FACIAL LASER RESURFACING

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Background: The combination of simultaneous surgical rhytidectomy with ablative resurfacing has been a controversial procedure due to the concern of postoperative wound healing. Traditional ablative resurfacing lasers lead to compromise of the dermal vascular perfusion, leading to delayed healing and skin flap loss when combined with face rhytidectomy surgeries. With the development of fractionated ablative laser therapy, improved skin perfusion has been showed. The objective of this study is to evaluate the clinical outcomes of patients undergoing simultaneous full-face rhytidectomy in combination with fractionated ablative skin resurfacing.

Study: A retrospective chart analysis was performed for all patients who had a combined procedure of facelift and ablative fractional laser resurfacing from 2008 to 2013 by the senior author (SKS). Postoperative recovery and complications were recorded. The surgical technique used for performing the facelift was an (SKS). Postoperative recovery and complications were recorded. The surgical technique used for performing the facelift was an extended supratemporal dissection with SMAS plication. Fraxel Re:Pair 10,600 nm fractional carbon dioxide laser was used to perform an ablative resurfacing including the skin flaps.

Results: A total of 86 patients were included. Average age was 60.01 years (range of 45–78 years). Longest follow up was five years. The average skin removed per side was 13.61 cm². The average size of the elevated skin flaps was 100 cm². Average skin type was a Fitzpatrick type 2. All patients had complete re-epithelialization by one week after their procedure. Four patients (4.6%) experienced acne outbreaks. Four patients (4.6%) had facial erythema that persisted greater than two weeks. Of these four patients, all resolved by five weeks postoperatively. There was no delayed wound healing or skin flap loss observed.

Conclusion: Our results indicate that simultaneous rhytidectomy with fractionated ablative laser resurfacing does not cause an increase in complications. Due to improved patient outcomes with combining these procedures, we believe that this can be increasingly offered as a safe combination.

#29

SKIN REJUVENATION USING COMBINED INFRARED/RF AND FRACTIONAL SUBLATIVE RF TREATMENT

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Background: Improvement of skin texture, as manifested by clarity of skin tone and texture, is commonly sought in today's aesthetic arena. A variety of techniques are currently available for this application, ranging from invasive resurfacing to gentle non-ablative light devices. Recently, a combined treatment that includes two consecutive procedures was introduced. The first procedure delivers infrared light (700–1200 nm) combined with non-invasive bi-polar radiofrequency (RF). This procedure was followed by delivery of fractional ablative radiofrequency.

Study: There were 10 female subjects enrolled in this prospective study, mean age 53. Skin types I-III and Fitzpatrick Elastosis Score 2–6. Each received a single treatment and follow-up was done at 6 weeks, 12 weeks and 24 week, and were asked to rank their improvement compared to baseline. Investigator evaluation was also done at the 6 week, 12 weeks and 24 weeks follow-ups to rank improvement in skin texture and overall appearance of the skin using the Global Aesthetic Index.

Results: At 6 weeks, investigator evaluations showed that 40% of the subjects had a GAI score of 2, 50% of the subjects had GAI score 1, and 1 subject had a score of 0. At 12 weeks, the investigator GAI scores were: 44% had GAI score 2, 22% had GAI score 1, and 33% had a score of 0. At 24 weeks 37% had a GAI score of 1 while 63% had a score of 0. Subject evaluation results at 6, 12 and 24 weeks were: 90% saw improvement compared to baseline, 77% saw improvement compared to baseline, and 62% saw improvement compared to baseline.

Conclusion: This study demonstrated that a single treatment session of the combined infrared/bipolar RF and fractional sublative RF is a safe and effective procedure for mild improvement of skin tone and texture.

#30

TREATMENT OF FACIAL PHOTODAMAGE AND RHYTIDES USING A PICOSECOND PULSED ALEXANDRITE LASER AND SPECIALLY DESIGNED FOCUS OPTIC

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McDaniel Institute of Anti Aging Research, Virginia Beach, VA

Background: Fractional lasers are popular methods for the treatment of photaged skin and pigment dyschromias. The addition of a specially designed focus optic (non-ablative diffractive optic) for optimal coverage and picosecond pulse to an alexandrite laser has been proven safe and effective for removal of pigment and tattoo ink via photomechanical impact.

Study: 20 healthy female subjects were treated with a picosecond pulsed alexandrite laser with a focus optic. Treatment protocol was for subjects to receive 4 full facial treatments at one month intervals with follow-up at 1 and 3 months post fourth treatment
Ten healthy subjects underwent three split face-facial study: pulsing system as compared to a similar wavelength dual band technology using either single or dual band technology. Different technologies are rarely compared to each other. To assess the safety and efficacy of a single band (500–600 nm) pulsated light technologies are rarely compared to each other. To assess the safety and efficacy of a single band (500–600 nm) pulsated light technologies are rarely compared to each other. To assess the safety and efficacy of a single band (500–600 nm) pulsated light technologies are rarely compared to each other. To assess the safety and efficacy of a single band (500–600 nm) pulsated light technologies are rarely compared to each other.

Results: Expert grading was done using a quartile improvement scale for: Fine Lines/Wrinkles, Redness, Pigment Dyschromia and Global Photodamage. Expert Grader data one month post first treatment demonstrated that all subjects showed some improvement in Global Photodamage. 50% showed mild improvement in the appearance of Global Photodamage, 40% had moderate improvement and 10% had marked improvement. Evaluation of Redness showed 25% had mild improvement, 10% had moderate improvement and 5% had marked improvement. All subjects showed improvement in Pigment Dyschromia; 15% showed mild improvement, 65% moderate improvement; and 20% showing marked dyschromia improvement. Fine Lines/Wrinkles showed mild improvement in 50%, moderate improvement in 25% and marked improvement in 10% of subjects. No adverse events occurred.

Conclusion: These preliminary results show significant reduction in Pigment Dyschromia and Global Photodamage in all subjects. Reduction in fine lines was observed in most subjects. 3 month follow up and biopsy results for six subjects will be available for the annual meeting. The rapid, significant improvement in photosaging using a photomechanical picosecond laser warrants further investigation into the mechanism of action.

A SPLIT-FACE COMPARISON BETWEEN SINGLE BAND vs DUAL BAND PULSED LIGHT TECHNOLOGY FOR THE TREATMENT OF PHOTODAMAGE

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Background: Photodamage is often treated with pulsed light technology using either single or dual band technology. Different pulsed light technologies are rarely compared to each other. To assess the safety and efficacy of a single band (500–600 nm) pulsing system as compared to a similar wavelength dual band delivery system in the treatment of photodamaged facial skin.

Study: Ten healthy subjects underwent three split face-facial treatments with the single band technique on one side of the face and the dual band treatment on the other side. Delivered energies were similar. Each treatment was administered at 4 week intervals (3 treatments). A blinded investigator assessed the photographs and rated each side for improvement in telangiectasias, pigmentation and skin texture. A subject satisfaction questionnaire was also given.

Results: Both sides of the face displayed comparable improvement in telangiectasias, pigmentation and skin texture. Although there were some minor differences, the two methods were not significantly different from each other.

Conclusion: Single band pulsed light treatment yielded results that are comparable to dual band technology. Both devices were safe and effective in the treatment for photodamaged facial skin.

A SPLIT FACE HISTOLOGICAL, BIOCHEMICAL AND CLINICAL EVALUATION OF CLINICAL EFFICACY OF NON-INVASIVE RADIOFREQUENCY TECHNOLOGY

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Background: Multiple non-invasive devices have been reported to achieve rejuvenation through controlled dermal collagen heating; however, most do not include histologic evidence of efficacy. In this study, a non-invasive bipolar radiofrequency (RF) device was used to heat dermal collagen; biochemical, histologic, and clinical endpoints were determined.

Study: Four patients undergoing elective rhytidectomy (facelift) were randomized to receive non-invasive RF treatment on one side of the face weekly for 8 weeks and no treatment on the other side (control) prior to surgery. At the time of rhytidectomy, multiple paired skin samples from each patient (treatment and control) were harvested from the facelift flap in different facial regions. Twenty-four histologic samples were then morphometrically analyzed for quantitative changes in size and structure of collagen utilizing computerized images of serial 4 μm thickness histologic sections. Collagen and elastic tissue synthesis, as assessed by spectrophotometric analysis, was also determined. Blinded physicians compared pre and post-treatment photography, utilizing Fitzpatrick scores, to determine clinical efficacy.
Results: Collagen fibers were observed to be thicker and more compact in RF treated skin as assessed by histologic/morphometric analysis. The content of collagen was 61.16% in RF treated skin versus 56.67% in untreated skin, an increase in collagen of 7.9% (P = 0.03). Collagen synthesis was increased significantly in RF treated skin (16.81 µg/mg vs 12.48 µg/mg in untreated skin, 34.7% increase, P = 0.003). Elastic tissue synthesis was unaffected. Significant clinical improvement was observed in RF treated skin, an average improvement of 1.5 points in Fitzpatrick score in treated versus untreated skin. No adverse events were observed. Conclusion: This split face study documents the histologic and biochemical changes following a series of non-invasive radiofrequency treatments. Objective histologic improvements, including collagen remodeling and neocollagenesis, were noted. Corresponding clinical improvements were observed. This novel RF device may be a valuable addition to rejuvenation treatments to induce dermal heating, collagen remodeling and rejuvenation.

#34
FILLER AND ENERGY - BASED DEVICE COMBINATION TREATMENT
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Background: The rejuvenation process has changed along over the past years, from a dermatologic point of view. Since the whole of skin, bone structure, fat and muscle is well known in the aging process, the combination of technologies and fillers has grown in order to achieve a more natural, efficient and non-invasive youthful appearance.

Study: A 45 years, female, pre-menopausal, non-smoking and no concomitant diseases was chosen to receive a split thigh study about the behavior of fillers: hyaluronic acid (HA) – (Voluma R/ Allergan) and calcium hydroxyapatite (CH) – (Radiesse R/Merz) followed by ablative and non-ablative lasers, microfocused ultrasound. A 20 x 5 cm rectangle was designated in both inner thighs. Each rectangle were divided into 4 squares (5 x 5 cm) one for control and the others for interaction with CO2 laser (Active Deep FX R – Lumenis), Er:YAG 1540 (1540 nm Starlux R – Palomar) and microfocused ultrasound (Ulthera R), each square was divided into 4 mini squares (2.5 x 2.5 cm) where biopsies were taken. All mini squares were injected from subcutaneous to superficial dermis until a papula was seen. The right thigh was injected with HA and left thigh was injected with CH. Immediately after the filler the technologies were done covering the area over the fillers and including control area. Timing of the biopsies was: D0, D15, D30, D90 and histologic findings of the state of the filler and associated inflammation were compared.

Results: The biopsies were stained with H&E and showed no significant differences in the appearance of the fillers nor the inflammatory process when compared to each control square. There were differences in the inflammatory process between HA and CH, only between the biopsies D15, D30 and D90 where the CH one showed more of an inflammatory process around the filler, which is expected as it is a bioestimulator with volumizing properties.

Conclusion: Clinician fear combining those procedures since theoretically the heating process could start a dense inflammatory response and potentially lead to a foreign body reaction, or the filler could change in appearance and its characteristics after being heated. We suggest, through these findings, that no granuloma, or histologic changes in the filler appearance or the filler efficacy were seen after exposure to CO2 laser, Er:YAG or microfocused ultrasound.

#36
PROSPECTIVE, MULTI-CENTER, PIVOTAL TRIAL EVALUATING THE SAFETY AND EFFECTIVENESS OF MICRO-FOCUSED ULTRASOUND WITH VISUALIZATION (MFU-V) FOR IMPROVEMENT IN LINES AND WRINKLES OF THE DÉCOLLÈTE
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Background: To demonstrate aesthetic improvement in lines and wrinkles of the décolleté with MFU-V.

Study: 124 female subjects meeting inclusion and exclusion criteria were enrolled and completed one treatment on the chest using three transducers: 4–4.5 mm (1.2 J), 7–3.0 mm (0.45 J), and 10–1.5 mm (0.20 J). Pain was assessed using a validated scale (0–10) during the treatment. Standardized photographs were taken prior to treatment, immediately after treatment, and at each follow-up visit (day 90 and 180). Efficacy will be determined by blinded masked assessments at 180 days post treatment compared to baseline. Physician Global Aesthetic Improvement Scale (PG AIS) scores and Patient Satisfaction Questionnaire (PSQ) responses will be tabulated at days 90 and 180 post-treatment.

Results: 124 female subjects with a mean age of 56.7 years old (37–70), mean BMI of 24.8 and Fitzpatrick skin types I–IV (1%, I1 - 49%, III - 41% and IV - 9%) were enrolled. The mean pain score at each depth was 6.2 at 4.5 mm, 5.8 at 3.0 mm, and 4.8 at 1.5 mm. At time of submission, 116 subjects have completed Visit 2 (day 90) and 109 subjects have completed Visit 3 (day 180). PG AIS scores show 75.0% have improved at 90 days and 66.0% at 180 days. 84% of subjects noted an improvement and 65.5% were satisfied at the 90 day visit. Visit 3 (day 180) results show a similar trend with 83% of subjects noting improvement and 62.4% satisfied. Device related adverse events (AE) reported have been mild tenderness and/or erythema, seen in 47% and 27% of subjects respectively.

Conclusion: According to interim results, improvement in overall chest wrinkle improvement has been demonstrated after one MFU-V treatment at 90 and 180 days post-treatment. The primary limitation is that presently only preliminary data is available, blinded masked assessments will be completed by October 31, 2013.

#37
A RETROSPECTIVE EVALUATION OF MICRO-FOCUSED ULTRASOUND WITH VISUALIZATION FOR LIFTING AND TIGHTENING OF THE FACE AND NECK
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Background: Evaluate efficacy of Micro-focused Ultrasound (MFU-V) for non-invasive treatment of skin texture and laxity of the face and neck.
**Study:** Fifty-five subjects treated with MFU-V to face and upper neck at dual depths using 4–4.5 mm, 7–4.5 mm and 7–3.0 mm transducer(s) were contacted for enrollment. Photographs were taken before and immediately after treatment and 90 and 180 days post treatment. Efficacy (lifting, tightening, and improvement of skin texture) was determined by masked assessment of upper, mid and lower face regions at 180 days (0–5 scale) and physician and subject global aesthetic improvement scores (PGAIS and SGAIS, 1 = very much improved, 5 = worst) and patient satisfaction at 90 and 180 days.

**Results:** Forty-eight female subjects, ranging in age from 39–85 years (mean 58) with mean BMI of 22.1 (range 17.9–30.8) were treated with approximately 500 total lines. Mean SGAIS was 3.1 ($P = 0.001$) and 2.9 ($P < 0.0001$) at day 90 (n = 16) and 180 (n = 45). Mean PGAIS was 2.8 ($P = 0.005$) and 2.8 ($P < 0.0003$) at 90 and 180 days respectively. 81.3% and 84.4% of subjects noticed an improvement at 90 and 180 days, respectively. 62.5% and 60.0% reported being “satisfied” or “very satisfied” with the treatment at 90 and 180 days respectively. 81.3% and 84.4% of subjects noticed improvement at 90 days and 73.7% at 180 days, most noting less sagging and smoother skin texture. 59.3% and 68.4% of subjects were satisfied or very satisfied with results at 90 and 180 days respectively. Masked assessments of baseline photos compared to D90 photos noted 36% improvement. No serious adverse events were reported. No treatment related adverse events were reported.

**Conclusion:** This study suggests that MFU-V is a promising nonsurgical option for lifting, tightening, and smoothing of the buttocks. Further evaluation with higher densities are needed to optimize this treatment.

#39

**CLINICAL EVALUATION OF THE EFFICACY AND TOLERANCE OF COMBINING A TOPICAL TIGHTENING AGENT IN CONJUNCTION WITH A RADIOFREQUENCY PROCEDURE**

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**Background:** Skin laxity and cellulite on the buttocks and thighs are two common cosmetic concerns. Skin tightening with radiofrequency (RF) devices has become increasingly popular. The purpose of this study is to evaluate the efficacy and safety of a topical skin laxity tightening agent when used in combination with an RF device.

**Study:** A double-blinded, randomized clinical trial enrolled twenty females with mild to moderate skin laxity on the posterior thighs/buttocks. Each subject underwent two monthly treatments with a radiofrequency source (Alma Accent) to both legs. Subjects were then randomized to apply a topical agent (Skinceuticals Body Tightening Concentrate) twice daily to only one designated thigh/buttock throughout the eight week duration of the study. All subjects were evaluated for improvement in lifting, skin tone, radiance, firmness/tightness, skin texture, and overall appearance based on photographic evaluation by blinded investigators at 12 weeks following the final RF treatment.

**Results:** A statistically significant improvement was found in overall appearance on both sides treated with the RF device when compared to baseline. However, the area treated with the topical agent showed a statistically significantly greater degree of improvement compared to the side where no topical agent was applied. No adverse effects were reported.

**Conclusion:** The use of a novel skin tightening agent used post RF procedures is both safe and effective for treatment of skin laxity on the buttocks and thighs. Combined therapy leads to a better result.

#40

**GOING DEEPER, A NEW APPROACH TO SKIN TIGHTENING: INTEGRATING THE USE OF SKIN THERMAL IMAGING WITH SUBSURFACE RF PROBE FEEDBACK LOOP HEATING**

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**Background:** The ability to safely use a subsurface, percutaneous directed energy form to achieve dermal, fibroseptal, and possibly fascial collagen tightening has been elusive. All present skin tightening uses are transdermal, with tissue depths, not true tissue target depth, but rather depth from the skin surface, relying of laser wavelength, RF vibrational wavelength, or fixed depth of array of microfocused ultrasound. A new method of achieving
tightening of tightening of skin, of directing RF energy to tighten skin, underlying fibroepithelial, and fascial structure with the use of a percutaneous RF energy thermistor probe was evaluated as to safety and efficacy in this clinical evaluation of 82 patients. 

**Study:** RF thermistor probes, 18 gauge, 10 and 15 cm lengths were used, after tumescent infiltration, with percutaneous placement and movement. Subsurface defaults for autofeed back loop safety were between 50 to 60°C. Monitoring for both safety and targeting desired skin surface temperature was achieved through thermal imaging. Of the 82 patients qualifying, by September 2013, for blinded as to pre and post treatment evaluation, 70 treatments were of the underchin and or jowel, of which 38 patients had no lipoaspirant, and 17 had an aspirant volume of less than 5 cc.

**Results:** A total of 70% of patients demonstrated a positive change in skin laxity score, of which, 83% saw at least a one category improvement, and for which 43%, the change was 2 points, on a 4 point scale. In only one patients was a transient localized vesicant response noted, otherwise no adverse incidence was noted.

**Conclusion:** Skin tightening can be achieved with a high degree of efficacy and safety with the use of a novel method of subsurface RF probe use when combined with skin thermal imaging.

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**#41**

**TOLERANCE OF 374 TREATMENTS WITH THE MICROFOCUSED ULTRASOUNDS FOR THE LAXITY OF THE FACE AND NECK**

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**Background:** Treatment with microfocused ultrasounds (Ulthera) is a new and interesting treatment for the laxity of the face (eyebrow and contour of the face) and the neck. The microfocused ultrasounds induce a very intense but precise thermal effect, increasing the local temperature to 64 Celsius, targeting the deep structures of the skin and the SMAS. The treatment needs usually one session, without visible long lasting side effects or downtime. We evaluate his tolerance on 374 consecutive sessions.

**Study:** 374 patients have been treated between June 2012 and September 2013. They received one treatment with the Ulthera Deepsee device, with the classical (face 5.0+) protocol = first pass with a 4.5 mm depth first, (energy of 0.9 to 1.2 joules, except the forehead: (one pass with a 3 mm depth only), and second pass with a 3 mm depth (energy of 0.3–0.45 Joules). The treatments were performed on the forehead only, in 54 cases, on the contour of the face alone in 115 cases, on the both areas in 205 cases. All patients were informed to systematically report any side effect, (except erythema, lasting usually less than 6 hours) and to consult in case of side effect. After one month, every patient was called by telephone to be sure that they did not observe any side effects.

**Results:** 12 patients were lost of follow up, without possible contact by telephone. The evaluation was possible on 362 patients: no severe or long lasting side effects were observed. We noticed 30 cases (8%) of small and limited areas of bruising, mainly on the neck, 5 cases (1.5%) of small hematomas (less than 1 cm in diameter), 12 cases (3%) of linear popular infiltration of the skin, lasting less than 2 weeks, and 15 cases of oedema of the neck or the submental area (lasting less than 4 days). On the eyelid, 10% of the patients noticed some swelling, never severe, and lasting less than 5 days. We did not observe any case of skin necrosis, scar, severe and/or lasting pain, or nerve disease.

**Conclusion:** The tolerance of the microfocused ultrasounds for the face and the neck is good, without downtime or severe risks. All side effects were transient and benign.

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**#42**

**EFFICACY FOR SAGGING SKIN USING A 90 WATT DYNAMIC MONOPOLAR RADIOFREQUENCY DEVICE-CLINICAL AND HISTOLOGIC STUDY**

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**Background:** This study was designed to evaluate the effectiveness of a newly designed treatment protocol for a dynamic radiofrequency device with bipolar grounding pad in the improvement of the appearance of skin tightening.

**Study:** This study completed 32 female subjects between 25 and 65 years of age who exhibited mild to moderate laxity of the skin around the chinstrap, mid and lower face. Subjects received 2 treatments with a dynamic monopolar RF handpiece equipped with intelligent impedance feedback based on a novel grounding pad. Treatments included mid face and chin strap area 10–14 days apart. 12 Subjects received ultrasound measurements (both high and lower resolution transducers) to the mid cheek. All subjects had digital images, clinical assessments and self-assessments at 1 and 3 month follow up. Biopsies were taken on 2 selected subjects from underneath the chin for histological examination. Clinical images were evaluated by physician evaluators.

**Results:** Skin ultrasound measurements (both the 22 MHz and the 50 MHz) recorded an increase in skin density (6% and 11%, respectively). The average live assessments demonstrate decreased Erythema (69%), improved Skin Laxity (22%) and improved Global Photodamage (15%). Self-assessments also showed strong average agreement (1.6/2.0 scale) that the treatment was effective for skin tightness and improved overall appearance (1.7/2.0). Physician expert quartile grading of photos demonstrated that 83% of subjects had a mild improvement in the three categories measured (Fine lines/wrinkles, skin laxity and overall skin texture). All subjects showed at least mild improvement in skin laxity at the 3 month time point. The average improvements for all subjects at 3 month follow up were 30% improvement in fine lines/wrinkles, 38% improvement in skin laxity and 44% improvement in overall skin texture. Histologic examination of the biopsies showed significant increase in dermal collagen and elastin fibers throughout the dermis in one subject and minimal change for the other subject. These findings correlate well with the respective subject’s clinical response (significant improvement for the first subject and almost no improvement for the second subject).

**Conclusion:** The study metrics indicate that this radiofrequency device treatment and protocol is an effective therapy for not only improving skin laxity, but also produced some overall fine line reduction.

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**#43**

**NON-SURGICAL FACE-LIFT MINIMALLY INVASIVE 1440 nm LASER TISSUE TIGHTENING ON FACE AND NECK**

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**Background:** From age of 40 onward, the neck begins to lose its contour. Laser technology provides additional benefits when treating the reticular-dermal and fibro-fascial-platysma layer of the neck. The objective of this study is to evaluate a minimally-invasive approach to treat unwanted skin laxity and fat in the
lower face, mandibular and submandibular areas with a new treatment modality which utilizes a pulsed laser that delivers 1440 nm energy to the dermal-hypodermal interface.

**Study:** 36 patients (33 female, 3 male) between 46 and 72 years of age (average 55.6) received a single laser treatment using the 1440 nm wavelength. Post tumescence infiltration, laser energy was emitted with an 800μm side-firing-fiber through three small incisions for lipolysis in the deeper fatty area and also for shallow heating of collagen fibers subdermally. Approximately 1200 joules were delivered per 5 x 5 cm² area through a temperature-sensing cannula. The treated fat was removed through vacuum aspiration using a 2 mm cannula.

**Results:** Patients tolerated treatment well with minimal bruising and swelling. A highly targeted delivery of thermal energy resulted in thickening and tightening of skin. Patient satisfaction was rated as 81.67% at 3 month follow-up. Physician rated the improvement as 60% in GAIS score and 70% in CAS score at 3 months follow-up. All patients would recommend this treatment to a friend or family member. No severe side effects were seen.

**Conclusion:** This new approach is safe and effective for the treatment of skin laxity in the lower third of the face and the neck, as well as subcutaneous fat in the submandibular area. Side effects and downtime is minimal, especially in comparison to other procedures. Patient satisfaction and acceptance was high.

**#44**

**ULTRASONIC AND HISTOLOGIC FINDINGS USING A 1440 nm Nd:YAG LASER FOR NECK CONTOURING AND SKIN TIGHTENING**

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**Background:** A novel 1440 nm Nd:YAG laser has been shown to be safe and effective for minimally invasive rejuvenation of the lower face and neck. The 1440 nm wavelength was chosen for its high affinity to water contained in both the skin and adipose tissue. This study demonstrates the histologic and ultrasonic changes that correlate with clinical skin tightening and improvement in the cervicomental angle.

**Study:** Twelve female subjects, Fitzpatrick skin types II to V, aged 46–63, presented for neck contouring in this prospective IRB approved study. Subjects signed informed consents. Each patient was given a single treatment with a 1440 nm Nd:YAG laser equipped with a unique side-firing fiber and temperature monitoring device and presented for follow-up at 1 week, 3 and 6 months post treatment. High resolution photographs, skin biopsies, ultrasound measurements, and satisfaction surveys were taken before and after treatment.

**Results:** Subjects averaged a 31% increase in skin thickness, as measured by ultrasound, with statistically significant results. Histologic findings demonstrated neocollagenesis and increased elastin in the mid-to-deep dermis as well as lipolysis of fat lobules. Both physician and subjects were satisfied or extremely satisfied in surveys conducted. Side-effects, as reported by subject diary for one week post-treatment, were mild to none. There were no serious adverse events. There were no changes in subject BMI.

**Conclusion:** This is the first study utilizing the 1440 nm Nd:YAG laser in the neck which demonstrates objective collagen remodeling and increased elastin in the skin. These ultrasonic and histologic findings correlate with the clinical improvement seen in neck contour. This minimally invasive procedure provides an alternative to rhytidectomy in properly selected patients.

**#45**

**RAPID REMOVAL OF RED TATTOO PIGMENT WITH A NOVEL 532 nm Nd:YAG PICOSECONDS LASER**

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**Background:** Until recently, Q-switched lasers have been the mainstay for the removal of unwanted tattoos. While often effective, these lasers can result in slow or incomplete clearance. More recently, the picosecond 755 nm Alexandrite laser has been proven to be an extremely successful alternative in the treatment of most tattoo pigments, especially blue and green. In this study, we evaluate a novel 532 nm Nd:YAG picosecond system for the removal of red tattoos.

**Study:** Single center prospective study of 20 previously untreated tattoos of predominantly red ink. Photographs were obtained at baseline and assessed by the investigator and blinded evaluators after one treatment session. The 532 nm Nd:YAG picosecond laser was used in the treatment of all tattoos with a spot size range of 2.5–5 mm, fluences of 0.3–1.2 J/cm², and pulse width of 475 picoseconds. All patients were anesthetized with local injection of lidocaine with epinephrine and the post treatment areas were treated with a topical viscous ointment.

**Results:** At initial follow up, subjects reported anticipated reactions including erythema, edema, crusting, and minimal blistering. Healing was noted within one week. Of importance, at least 75% clearance of the red pigment was noted in all tattoos as early as one week post one treatment.

**Conclusion:** Treatment of red tattoo pigment with the 532 nm Nd:YAG picosecond laser yielded greater than 75% clearance after one treatment session and is safe and well tolerated. No scarring or hypopigmentation was seen in the subject population.

**#46**

**SINGLE vs REPEAT EXPOSURE TATTOO REMOVAL DURING SINGLE SESSIONS WITH PICO-SECOND PULSE DURATION LASER TECHNOLOGY**

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**Background:** The treatment of unwanted tattoos has traditionally suffered variable results. Different ink colors and particle sizes do not always respond predictably to the wavelengths and pulse durations used for treatment. In the past, tattoo treatment consisted of a single pass using traditional Q-switched lasers with nanosecond range pulse durations. New technology has led to picosecond range pulse duration lasers which produce a very high peak power allowing for more rapid heating and photoacoustic shattering of the ink. New data also shows that multiple treatment passes separated by 20 minutes (R20 method) may improve efficacy of tattoo treatment sessions.

**Study:** Twenty-six tattoos on 20 adults were divided evenly and one half received a single treatment pass and the other half received 2 treatment passes separated by a 20 minute interval with a picosecond alexandrite laser (1.11–6.37 J/cm², 755 nm, 750-nanosecond pulse duration, 2.0–4.8 mm spot size). Each tattoo was treated at multiple sessions. The degree of tattoo lightening was graded by consensus provider evaluations of 6–8 week interval photos.
Results: After one session, the R20 method showed a 3.4 fold improvement in the tattoo from baseline. This compared to a 2.1 fold improvement in the single pass traditional treatment (P = 0.005). Following the 3rd session, the R20 treatment area had reached a 4.5 fold improvement from baseline while the traditional single pass improved the tattoo 3.3 fold (P = 0.002).

Conclusion: The R20 method may improve the efficacy of the new picosecond laser technology when treating tattoos. Multiple passes during each treatment session with the picosecond lasers can help to fracture the ink in a more efficient manner and lead to clearance of a tattoo in fewer treatments.

#47

DOSE OPTIMIZATION WITH A PICOSECOND 755 nm ALEXANDRITE LASER FOR TATTOO REMOVAL

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Background: The recent introduction of a picosecond alexandrite laser for tattoo removal presents a challenge to determine optimal dosing with a balance between efficacy and unwanted side effects. We studied the effects of this device on tattooed skin with a dose optimization based on clinical efficacy and side effects.

Study: 17 patients with tattoos classified with light, medium and heavy inking were treated with test spots of 1.3–4.1 J/cm² over the tattooed skin as well as over adjacent normal skin. Melanin index (MI) and skin typing of the normal skin adjacent to tattoos were recorded prior to the treatments. At 24 hours, the test spots were evaluated and photographed. Four treatments were conducted at 1 month intervals. Half of the tattoo was treated with the best tolerated fluence based on test spots and the other half was treated with escalating doses over the four treatments to a max fluence based on clinical response, not exceeding 4.1 J/cm².

Results: The response on adjacent un-tattooed skin and MI were predictive of the best tolerated fluence on the tattoo. At initial doses, fluences between 1.3 and 2.0 J/cm² were the best tolerated. Higher initial doses were associated with blistering, patient discomfort, transient hypopigmentation and post-inflammatory hyperpigmentation. Significant tattoo clearing was seen at lower fluences in the 1.3–2.0 Joulé/cm² range. However, dose escalation up to 4.1 J/cm² appeared to result in better tattoo clearance while minimizing the side effects.

Conclusion: Tattoo removal with the Picosecond alexandrite laser can be done at fluences from 1.3 to 2.0 Joulé/cm² with dose escalation based upon previous responses, skin-type, tanning and melanin index. Tanning, darker skin types, higher MI, and dense inking can be associated with blistering, transient hypopigmentation or post-inflammatory hyperpigmentation. Melanin absorption is a factor to be considered when treating a tattoo with this device.

#48

A PROSPECTIVE, RANDOMIZED SPLIT FACE STUDY EVALUATING THE EFFECT OF PULSE DURATION ON MELASMA TREATMENT USING A Q-SWITCHED 1064 nm LASER COMBINED WITH MICRODERMABRASION AND TOPICAL MEDICATIONS

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Background: Melasma is a common, often refractory problem worldwide that significantly affects quality of life measures. Treatment with a microdermabrasion and QS 1064 nm laser in combination with a daily topical regime (4% hydroquinone, 0.05% tretinoin and broad spectrum sunscreen) has recently gained widespread popularity. This split face study examines the effects of two different pulse durations (long vs. short) using this technique.

Study: Ten females (mean age 45 ± 9 years, skin type II-IV) underwent 3 treatments at 4 week intervals, with follow up visits (F/U) at 1, 3 and 6 months after the last treatment. Subjects were randomly assigned to have one half of their face treated with a ~70 ns pulsewidth (long), and the other side with a ~10 ns pulsewidth (short). A 5 mm or 6 mm spot size was used with a fluence of 1.6 J/cm². At each visit, a blinded investigator assessed the melasma severity using the Melasma Area and Severity Index (MASI).

Results: Baseline MASI scores for the long and short pulse duration groups were similar (15.9 ± 8.3, 15.5 ± 6.7 respectively; P > 0.05). As early as one month after the first the treatment, significant improvement was observed in both groups. There was a mean MASI score reduction of 4.3 ± 5.1, 1.7 ± 2.5 for the long and short pulse, respectively (P < 0.05). Long pulse-treated areas demonstrated significantly greater improvement compared with the short pulse-treated areas (P < 0.05) at each visit. The mean reduction in the MASI score for the long vs. short pulse-treated areas was 4.2 ± 3.0 vs. 2.2 ± 2.7 (after second treatment), 5.1 ± 4.6 vs. 3.4 ± 4.7 (1 month F/U), and 4.2 ± 2.4 vs. 3.7 ± 3.7 (3 month F/U). No adverse events were observed.

Conclusion: This study further supports the efficacy of the low fluence QS 1064 nm laser technique for improvement of facial melasma. The long pulse duration appears to be more efficacious than the short pulse duration.

#49

TREATMENT OF BENIGN PIGMENTED LESIONS WITH A NOVEL FREQUENCY-DOUBLED 532 nm PICOSECOND LASER

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Background: To date various treatment modalities, including the nanosecond Q-switched (QS) laser, have been effectively used to treat benign pigmented lesions. Shorter pulse durations of the picosecond laser, which could potentially achieve equivalent or higher peak temperatures while using less fluence further reducing damage to surrounding tissues, may be more effective in removal of pigmented lesions. We investigated the safety and efficacy of a novel frequency doubled 532 nm picosecond laser for the treatment of benign pigmented lesions of the hand.

Study: This was a single center study of 20 subjects (7 males and 13 females) with Fitzpatrick skin types I to III, mean age of 52 (42–67). Solar lentigines, ephelides and seborrheic keratosis of the hand were treated. A frequency doubled 532 nm picosecond laser (Picosecond Prototype Device, Cutera, Brisbane, CA) was used with spot sizes of 2.5–4.3 mm (mean of 3.0 mm), fluences of 0.5–1 J/cm² (mean of 0.75 J/cm²), and pulse duration of 550–740 picoseconds (mean of 640 ps). Up to two treatments were performed 6 weeks apart. Standardized photographs were taken at baseline and 12 weeks following the final treatment. Blinded assessment of
Improvement (clearing) in pigmented lesions was completed by two independent dermatologists using a 4 point improvement scale (0 = No Change, 1 = Improved, 2 = Much Improved, 3 = Very Much Improved). Pain levels (0–10 numeric rating scale) and adverse events were recorded.

Results: Based on blinded photographic assessments of 11 subjects, treatments resulted in a clinically and statistically significant median improvement of 1.50 (one-sample Wilcoxon signed rank test, 95% CI: 1.00–2.25, \( P = 0.006 \)). The reviewers were highly consistent (inter-reviewer reliability, kappa of 0.82), and highly accurate (inter-reviewer validity, kappa of 0.91) in identification of the before and after photographs. Eighty-two percent of subjects received single treatment. Improvement was observed in 91% of subjects at 12 week follow-up. No hyperpigmentation and scarring have been reported. Treatments were tolerated well (mean pain score of 2). Results for all subjects will be available in December 2013.

Conclusion: Treatment of benign epidermal pigmented lesions of the hand with a novel frequency doubled 532 nm picosecond laser was found to be safe and effective, with minimal discomfort and side effects in Fitzpatrick skin types I–III.

#50

A SPLIT FACE MULTI-CENTER STUDY TO DOCUMENT THE SAFETY AND EFFICACY OF CLEARANCE OF MELASMA WITH A 5 NS Q-SWITCHED Nd:YAG LASER VERSUS A 50 NS Q-SWITCHED Nd:YAG LASER

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Background: To determine the safety and efficacy of a 50 ns Q-switched Nd:YAG laser vs a 5 ns Q-switched Nd:YAG laser for clearance of melasma. To compare subject satisfaction, efficacy, and comfort level between the two lasers.

Study: This is a prospective, randomized split face clinical study. The study was approved by the Scripps IRB. Ten healthy female subjects with severe to moderate melasma were enrolled. Each subject had three laser treatments one month apart. Patients were followed up approximately 1 month, 3 months and 6 months after the final laser treatment. A treatment session consisted of a microdermabrasion of the entire face followed immediately by treatment to one side with a 50 ns 1064 nm QS laser and the other side with a 5 ns 1064 nm QS laser. Fluence was set at 1.6 J/cm² with a 6 mm spot size and two laser doses were applied.

Immediately post treatment 0.05% fluocinolone cream was applied. The treatment also included a daily skin care regimen comprised of topical 4% hydroquinone, 0.05% tretinoin cream and SPF 50 sunscreen. Subjects were asked to rate treatment pain based on a numerical scale range 0–10 (0 = no pain and 10 = worst pain). A melasma area and severity index (MASI) grading system was applied by the investigators at baseline and at each subsequent visit to evaluate the response to treatment. Also, melanin measurements were acquired by a reflectance spectrophotometer at each visit at the same facial site. Side effects were documented during the study including post treatment erythema. Erythema assessment using a clinical assessment scale of 0 = absent, 1 = mild, 2 = moderate and 3 = severe was used.

Results: Eight patients completed the study. Subjects showed improvement on both sides of the face. From baseline to 1 month post the final laser treatment, the average MASI scores showed a 16% reduction for the 50 ns QS 1064 nm laser vs a 27% reduction for the 5 ns QS 1064 nm laser (both significant versus baseline pigment, \( P < 0.05 \)). This difference in MASI scores between the two lasers was not statistically significant (\( P = 0.87930 \)). Laser treatments displayed mild erythema that resolved after one day. The melanin meter measurements showed a reduction in pigment readings on both sides. 3 months after the final treatment there was some relapse in the melasma, as the mean pigment reduction fell and to 12% for the 50 ns laser and 11% for the 5 ns laser. By 3 months pigment reduction was not statistically significant for either laser, and no significant differences in pigment reduction were noted between the two pulse durations. There was a statistically significant difference (\( P < 0.05 \)) in pain scores reported by the subjects (scale 0–10) the mean pain score for 50 ns QS 1064 nm laser was 1.2 and for the 5 ns QS 2.9 the score was 2.9.

Conclusion: In this study we showed that a combination of microdermabrasion, QS 1064 nm laser and topical (hydroquinone and 0.05% tretinoin cream) decreased the MASI and meter scores without clinically significant side effects. Moreover, the longer pulsed Q-switched 1064 nm laser i.e. (50 ns) was associated with less pain than its shorter pulse width counterpart.

#51

EXCIMER LIGHT MONOTHERAPY vs COMBINED EXCIMER LIGHT AND TOPICAL ANTIOXIDANTS IN THE TREATMENT OF VITILIGO

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Background: Vitiligo is an acquired idiopathic cutaneous disease. There are several hypothesis concerning the pathogenesis of vitiligo. Various medical and surgical therapeutic options were proposed for repigmentation of the lesions. The aim of this work was to compare the efficacy of combined excimer light and topical antioxidants versus excimer light as monotherapy for vitiligo. Study: The study included 30 patients with 90 vitiligo macules and 30 control lesions. Vitiligo lesions were divided into 2 groups. Group A treated with combination therapy using 308 nm excimer light and topical antioxidant hydrogel (superoxide dismutase, copper, zinc, vit.B12 and calcium pantothenate). Group B treated with excimer light 308 nm as monotherapy. Excimer light was performed twice per week for 24 sessions, hydrogel was applied twice per day for group A only.

Results: Group A: Excellent response in 20% of lesions, good in 26.7%, moderate in 22.2%, poor in 22.2% and no response in 8.9%. Group B: showed 48.9% moderate response, 42.2% poor response and 8.9% no response.

Conclusion: We conclude the present study revealed that both the combination treatment of excimer light 308 nm with antioxidants and excimer light monotherapy gave repigmentation in 91% of the treated macules. But the combination treatment was more effective in reaching excellent response than monotherapy.

#52

DEVELOPMENT OF THE VISUALLY-GUIDED AND ROBOT-ASSISTED AUTONOMOUS LASER HAIR REMOVAL SYSTEM

Hyoung-woo Lim, Sungwoo Park, Seungwoo Noh, Dong Hun Lee, Chiyeul Yoon, Choong Hee Lee,
ABDOMINAL CIRCUMFERENCE REDUCTION USING A NEW HIGH POWER RADIOFREQUENCY TECHNOLOGY COMBINED WITH INFRARED LIGHT AND MECHANICAL MANIPULATION FOR BODY CONTOURING TREATMENT

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Background: A growing demand for fat reduction and skin tightening, with minimal downtime, has led to recent developments of new non-invasive body contouring devices. We previously demonstrated that combining bi-polar radiofrequency and infrared optical energies with tissue manipulation is an efficient reshaping modality. Here, we investigated the performance of a new high power version (200 W) of this combined technology.

Study: A combined high power Bipolar RF, IR and mechanical manipulation device was tested in a multi-center, prospective study in 4 US sites. 47 patients (47 female; mean ± SD age of 42 ± 11 years) received six weekly treatments on the abdomen and flanks and followed post treatment completion to 3 months. Abdominal circumference was measured at reproducible sites at baseline and post treatments via tape measure, ultrasound, and in some cases 3-d imaging. Patients with over a ± 5 Kg change were excluded from data calculation.

Results: We observed a significant decline in abdominal circumference on 1 and 4 weeks post final treatment, with reductions of 2.0 and 1.8 cm respectively ($P < 0.05$; paired t-test). On 12 week post final treatment, a mean reduction of 1.2 cm was observed. Ultrasound obtained at one site demonstrated fat thickness reduction of 5.0, 4.80, and 5.6 mm on 1, 4 and 12 weeks post treatment ($P < 0.05$; paired t-test). Vectra imaging confirmed the reductions documented post treatment. The procedure was well tolerated; one patient developed shingles on the abdomen, which resolved. Lipid profile results were not clinically significant, with a 3 month post treatment change of -11.2, +10, +3.8, and +3.5 mg/dl on triglycerides, cholesterol, LDL, and HDL respectively.

Conclusion: The present study performed with a new application of high power RF energy combined with IR and mechanical vacuum appears to be safe and well tolerated. Objective improvement was demonstrated at three months post treatment, and the device is an added safe modality for abdominal circumferences reduction.

#53

CRYOLIPOLYSIS USING THE TREATMENT TO TRANSFORMATION APPROACH: ONE YEAR FOLLOW-UP

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Background: Approximately one year ago, the Treatment to Transformation (T2T) approach was introduced. T2T is an optimized cryolipolysis treatment protocol that utilizes a global approach with repeat cycles delivered to the same areas or additional treatments delivered to new areas, as needed. At ASLMS 2013, preliminary 2 month study results were presented showing that T2T resulted in global fat reduction, optimized clinical outcomes, and increased patient satisfaction. This presentation will share follow-up results at 4 month and 1 year time points.

Study: In a multi-center study, $n = 26$ subjects received cryolipolysis treatment (CoolSculpting, ZELTIQ Aesthetics, Pleasanton, CA) in the abdomen, flanks, back, arm, inner thighs, knees, and chest. Follow-up visits took place 2 and 4 months post-treatment to evaluate side effects and efficacy. At 2 months, additional treatments were delivered to new areas or repeat treatments were given to the same sites. Approximately 1 year post-treatment, available subjects returned for follow-up with ultrasound measurements, clinical photographs, and self-assessment questionnaires.

Results: One-year follow-up is currently in progress. Interim ultrasound results show appreciable reduction in fat layer thickness. Questionnaires indicated high patient satisfaction,
visible fat reduction, procedural tolerability, and desire to have additional CoolSculpting treatments. Blinded, independent photographic review found high incidence of correct identification of baseline images.

Conclusion: To the best of the investigators’ knowledge, this is the first report of long-term safety, efficacy, and satisfaction for cryolipolysis T2T patients. The T2T treatment approach was designed to deliver cryolipolysis to multiple sites to achieve global fat reduction, optimized clinical outcomes, and increased patient satisfaction. From 4 clinical study sites treating 26 patients, this study investigated treatment to the abdomen, flanks, arms, inner thighs, chest, knees, and back. No serious adverse events were reported. Long-term fat layer reduction was achieved over multiple treatment areas, yielding high patient satisfaction.

#55
MIRCRO-NEEDLE FRACTIONAL BIPOLAR RADIOFREQUENCY FOR THE TREATMENT OF SKIN LAXITY AND CELLULITE OF THE BUTTOCK

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Background: Minimally invasive radiofrequency devices have shown a great improvement when used for improvement of skin laxity. Micro-needle bipolar radiofrequency (RF) represents a more aggressive, yet highly precise method to deliver heat based energy. Such an approach can deliver bi-polar RF energy directly into the deep reticular dermis to create fractional zones of thermal injuries.

Study: The purpose of this study is to determine the safety and efficacy of a micro-needle fractional bipolar radiofrequency for the treatment of lax skin and cellulite of the buttock. Fifteen subjects were treated unilaterally with a micro-needle fractional bipolar radiofrequency device (ePrime, Syneron Candela) on the mid-lateral region of the buttock. Subjects had an optional treatment to the other side at 6 months post-treatment. Standardized photographs were taken at every visit from baseline to the 6-month follow up. Efficacy measures using the Pittsburgh Rating scale, physician and subject global aesthetic improvement scale (PGAIS) were undertaken. Adverse events were also evaluated. Data analysis was undertaken with one-way ANOVA statistical analysis.

Results: Micro-needle fractional bipolar radiofrequency treatment showed a statistically significant improvement in both skin laxity and cellulite. Results suggest a progressive linear effect over the course of 6 months. No serious complications were noted.

Conclusion: Minimally invasive bi-polar radiofrequency treatment is an effective non-surgical treatment for the improvement of skin tightening and cellulite of the buttock.

#56
CLINICAL AND BIOLOGICAL ASSESSMENT OF NON-INVASIVE RADIOFREQUENCY FOR SIMULTANEOUS REDUCTION OF ADIPOSE TISSUE AND REMODELLING OF COLLAGEN

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Background: Multiple new technologies have been proposed for non-invasive adipose reduction, but none simultaneously specifically target fat while also remodeling collagen. In this study, a non-invasive radiofrequency (RF) device was used for body contouring; clinical and histologic endpoints were determined to assess efficacy on adipose tissue and collagen.

Study: Twenty-four patients underwent six weekly non-invasive RF treatments to the abdomen; clinical outcomes including abdominal circumference, adipose tissue thickness (measured by ultrasound), adipose tissue weight, body weight, and clinical photographs were compared at baseline, 1, 3, and 6 months post procedure. Three patients, undergoing elective abdominoplasty, were randomized to receive RF treatments on one side of abdomen only with the contralateral side serving as control. Matched histologic specimens from the RF treated and control side of these patients were then analyzed for adipocyte size and shape, rate of apoptosis, collagen production, and dermal thickness.

Results: Significant clinical improvements ($P < 0.05$) were observed for the following clinical outcomes at 3/6 month follow-up: reduction of abdominal circumference, reduction of subcutaneous adipose tissue thickness, and reduction in adipose tissue weight. Histologically, adipocytes were observed to have decreased size and withered shape, with increased levels of apoptosis; increased collagen synthesis, with compaction and reorganization of the dermis was also observed.

Conclusion: This RF device was shown to have clinical efficacy in reduction of subcutaneous fat thickness and weight, as well as reductions in abdominal circumference. Histology documented adipocyte apoptosis as the mechanism of action with simultaneous remodelling of collagen and collagen synthesis. This device appears to combine the two main endpoints of body contouring in a single technology: reduction of subcutaneous fat with the simultaneous tightening/remodelling of overlying collagen.

#57
CLINICAL AND HISTOLOGICAL EVALUATIONS OF A NOVEL 1060 nm LASER DEVICE FOR NON-INVASIVE FAT REDUCTION

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Background: Cryolipolysis, through hypothermic treatment, has been shown to induce adipocyte injury and thus used as an alternative to liposuction for fat reduction. In this study, we assessed the use of hyperthermic treatment to cause the same type of injury to adipocytes and compare the safety and efficacy profile to cryolipolysis. Similar to cryolipolysis, a hyperthermic treatment which raises tissue temperature to 42–47°C is proposed to have similar effects resulting in adipocyte injury.

Study: Seventeen subjects were recruited for two prospective IRB approved studies. 11 subjects were treated with a 1060 nm laser on the abdomen prior to scheduled abdominoplasty. Clinical and histological evaluations were conducted to determine the effectiveness of adipocyte damage and severity of side effects at titrated laser dosages. Following this, a total of six subjects in a split study were then treated with either the laser treatment or cryolipolysis on each flank. Patients were assessed at one week for side effects. Ultrasound measurements of fat thickness and MRI analysis of fat volume were conducted to quantify the treatment efficacy at 1, 2, 3, and 6 months. Standard photograph and side effects were recorded.

Results: Tissue specimens taken from day 0 to 6 months showed evidence of adipocyte damage starting at 1 week post treatment
and continued phagocytosis up to 6 months. Comparisons of Ultrasound and MRI measurements between the two types of treatments showed similar results. Photo evaluations also showed similar aesthetic alteration. Both types of treatments were well-tolerated by all subjects with no calculated damage to the epidermis at any tested dosage. Side effects included mild pain and numbness that resolved within 2 weeks.

**Conclusion:** Histologic, quantitative measurements, as well as aesthetic level of improvement show comparable results between hyperthermic and hypothermic treatment of adipocytes resulting in fat reduction.

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**SECOND GENERATION MINIMALLY INVASIVE LASER TREATMENT OF CELLULITE**

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**Background:** This pilot study was designed to determine safety and effectiveness of laser treatment parameters with 1319 nm wavelength fiber laser for improved appearance of surface irregularities of skin on lateral thigh and buttock regions seen in women (cellulite).

**Study:** Eleven females, ages ranging from 25 to 46, average 40, were treated at two centers for contour irregularities of the thigh with multimode 1319 nm fiber laser delivery under tumescent anesthetic and oral sedation. Laser energy was applied to 5 cm by 5 cm squares using burst mode of 1319 nm to disrupt the fibrous bands thought to contribute to surface irregularities. Ultrasound was used to delineate and confirm ablation of fibrous septae.

Internal temperature sensing cannulas were utilized to monitor temperatures (ranges 48–50 °C). In phase two of the procedure, 1319 nm laser energy was delivered to target squares at lower peak powers with high frequency to create bulk heating (ranges 48–50 °C) while skin temperature was measured by infrared thermometers (<43 °C). Follow up was 2 weeks to monthly intervals (2–6 months). Subjective evaluation of outcomes was in 25 percentile increments as judged by patient and physician comparing results to preoperative photographic condition.

**Results:** The average amount of 1319 nm energy delivered per treated 25 cm² square was recorded. The average energies delivered were 863 J for septal rupture (burst mode) and 811 J (bulk heat mode). All patients had some resolution of irregular contours of treated areas within 2 to 6 month follow-up period. Minimal improvement seen was 25%. Highest improvement was 75%. The average for the 11 patients was 66%. There were no adverse events.

**Conclusion:** Soft tissue surface irregularities such as cellulite may be successfully treated with a 1319 nm wavelength fiber laser.

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**EVALUATION OF THE DECREASE OF SUBCUTANEOUS ADIPOSE TISSUE THICKNESS WITH COMBINATION OF PULSED FOCUSED ULTRASOUND AND RADIOFREQUENCY NON-INVASIVE TREATMENT**

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**Background:** Technical advances provide the possibility of achieving non-invasive lipolysis by the mechanical effect of pulsed focused ultrasound (PFU). Radiofrequency has shown its efficacy in skin tightening. Objectives: comparison of subcutaneous fat thickness decrease after treatment with single focused or double focused ultrasound treatment combined with integrated vacuum assisted radiofrequency (IVARF).


**Results:** Group A: 7 females, 3 males, Group B: 6 females, 4 males. Age: mean 48. BMI: mean 24. Contour decrement: Group A: mean 4.8 cm, Group B: 3.9 (P < 0.05). Pinch test decrement: Group A: 1.9 cm, Group B: 1.7 cm. US-measured subcutaneous thickness decrement: Group A: 26%, Group B: 20% (P < 0.05).

**Conclusion:** Results show the efficacy of combination of PFU and IVARF in the treatment of localized adipose deposits. This effect was slightly more significant when US were used in a single focused mode.

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**FIELD ARRAY RF FOR REDUCTION OF ABDOMINAL FAT: PILOT STUDY**

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**Background:** Selective fat reduction has been clearly shown for various energy modalities including cryolipolysis and high intensity focused ultrasound. Mathematical modeling of focused high frequency of the EM spectrum has indicated that selective heating of fat is possible using RF of 20 MHz and higher in a field array. This pilot study was performed to test the concept of fat reduction by a large field array of high frequency RF for abdominal fat.

**Study:** Utilizing a field RF device at maximum of 170 W placed 1–2 cm above the skin (Vanquish™ BTL Aesthetics, Prague, Czech Republic) 29 subjects between the ages of 18–68 with a body mass index (BMI) between 19.24–29.7 kg/m² were treated. Each subject received four treatments over a period of four to eight weeks. Treatments were administered on the anterior and lateral aspect of the abdomen and love handles. Circumferential reduction was measured at baseline and at one-month and 3 month follow-up visit. After the last treatment all participants completed the self-evaluate questionnaires and rated their level of satisfaction.

**Results:** Skin temperature was selectively monitored over the treatment area via the infrared thermal imager. The therapeutic temperature of 39–42.5 °C was achieved and maintained throughout the treatment. All of the subjects experienced a decrease in abdominal circumference. The decrease in circumference ranged from 2 cm up to 13 cm with an average decrease of 5.68 cm. Patient subject satisfaction was very satisfied.

**Conclusion:** Field array RF with a single applicator placed over the abdomen appears to be effective at reducing abdominal fat with 4 treatments. Side effects are minimal. This novel method of fat reduction requires further investigation.
#62

A NOVEL CAMERA DEVICE THAT CAPTURES TRYPTOPHAN AUTOFLOUORESCENCE IN RAPID EPIDERMAL PROLIFERATIONS

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**Background:** Autofluorescence is due to the presence of native tissue fluorophores. Tryptophan autofluorescence has been correlated to epidermal proliferation, but has not been imaged in human skin. We made a prototype camera device that captures tryptophan autofluorescence.

**Study:** An ultraviolet charge-coupled device (CCD) camera was filtered to detect 340 nm, and coupled to a 300 nm light emitting diode source, for imaging the excitation/emission pair of 300/340 nm characteristic of the tryptophan fluorophore. An in vivo murine tumor model for basal cell carcinoma (Pch1+/–) was used in a preclinical study. Clinical imaging was then performed in a pilot study on 23 subjects with various skin lesions. Images were also taken of frozen sections and compared to histology, when biopsies were taken as part of standard care.

**Results:** The 300 nm excitation source delivered 0.03 mJ/cm² during a 162 ms flash exposure, two orders of magnitude below the 3 mJ/cm² permissible exposure for skin at this wavelength. Skin tumors in the murine model failed to demonstrate tumor-specific autofluorescence images. In contrast, human skin lesions with rapid epidermal proliferation consistently showed increased autofluorescence compared with surrounding normal skin, including psoriasis, actinic keratoses and non-melanoma skin cancers.

**Conclusion:** This is the first study to image tryptophan autofluorescence in humans. The technique appears to be useful for detecting and/or evaluating proliferative skin lesions including skin cancers, and should be further pursued. Limitations include a small sample size and a simple point-and-shoot camera system that does not fully isolate tryptophan from other UV skin fluorophores. The fundamental basis for increased tryptophan autofluorescence in proliferative skin lesions remains unknown.

#63

ANALYSIS OF SITE SPECIFIC REAL-TIME MELANIN MEASUREMENTS TO OPTIMIZE TREATMENT SETTINGS AND AVOID COMPLICATIONS

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**Background:** We evaluated the predictive value of real-time Melanin Index (MI) measurements for determining appropriate intense pulsed light (IPL) treatment settings. Previous analyses of patients showed that maximum tolerated fluences (greatest fluence that did not cause crusting in normal background skin) were higher for smaller numbers of lighter discrete lesions in untanned facial skin (especially the central face) and lower for non-facial areas of slightly tanned skin with a greater density of darker pigmented lesions.

**Study:** Thirty-nine patients were treated on the face and 17 patients were treated on non-facial sites in this analysis.

A 3-wavelength (640, 700, 910 nm) backscattering reflectometer provided MI values transmitted to the base that then provided preset fluence value ranges based upon selection of pulse width and MI (Icon system and SkintelTM Melanin Reader, Cynosure, MA). In most cases, test spots (1 cm²) were performed at levels just below and above the suggested levels to establish validity and reproducibility of the fluences as a guiding factor in treatment parameter selection. The system was used in patients presenting for optimized pulsed light treatment with one of two IPL handpieces (MaxG™ and MaxYe™ Cynosure). Pulse width (10 ms) and fluence settings (selected based on eyeball assessment of experienced operators) were chosen and compared with suggested fluence settings provided by the system. Measurements and treatments were carried out over a range of skin regions including the face, arms, chest, and legs. A linear regression analysis was performed of the scatterplots of system-suggested value versus treatment fluence for the respective facial and body treatment sites.

**Results:** Based on the data, curves were generated for two IPL handpieces. Regional variations in epidermal tolerance were noted; central facial skin showed the greatest epidermal tolerance and extremity and chest skin the least. Thresholds for vascular lesion reduction were about 25 J/cm²/10 ms for the MaxG HP and ~36 J/cm²/15 ms for MaxYe’s HP. Approximately 90% of all the treatment fluences fell within the range of suggested treatment fluences. The other treatment parameters fell between 2 and 4 J/cm² below the minimum of the range, 2 of which were facial treatments. No parameter exceeded the maximum values of the range. Those parameters falling outside the range were on pigment (e.g., poikiloderma) normally treated with longer pulse widths. Individuals of different Fitzpatrick Skin Type, but with similar melanin content, were observed to continue to have similar skin tolerance. Regression analysis showed a slope 1 J/cm² per MI unit (Face) and 0.5 J/cm² per MI unit (Body).

**Conclusion:** Real-time measurement of skin’s melanin content was found to accurately guide selection of appropriate and safe photodermatologic treatment settings.

#64

LONG-TERM (13 YEARS) COMPARATIVE OUTCOMES OF DIFFERENT ENDOVENOUS THERMAL ABLATION SYSTEMS ON GREAT AND SMALL SAPHENOUS VEIN INSUFFICIENCY

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**Background:** Many treatment options available for the treatment of venous insufficiency of the great and small saphenous vein (GSV and SSV), including an endovenous thermal ablation (EVTA). There are many endovenous thermal ablation systems in the market. However, study comparing different systems with long-term follow-up is limited. Objectives: Over a decade, outcomes and side effects of EVTA for GSV and SSV insufficiency utilizing three different endovenous thermal ablation systems were examined.

**Study:** This retrospective study reviewed EVTA treatments performed and follow-up at an outpatient clinic (MDLSVI) over the 13-year period from April 1999 to February 2013. Systems included 810 nm diode (hemoglobin targeting), 1320 nm laser (water targeting) and a radiofrequency (RF) device. Clinical and ultrasonographic evaluations were performed before treatment
and at each follow-up visit. Patients were examined yearly by Duplex ultrasound. Success was defined as complete absence of reflux.

**Results:** Analysis of 935 treatments showed complete saphenous closure rates of 95.6%, 95.9%, 88.4%, 86.6%, 87.6%, and 86.7% at 1-week, 6-week, 6-month, 1-year, 5-year, and 10-year follow-up, respectively. Among 3 systems, success rates in GSV treatment were statistically significantly different at 6-weeks (P = 0.008; RF 93.5%, 810 nm 91.7%, and 1320 nm 97.9%) and 1-year (P < 0.001; RF 80.1%, 810 nm 73.3%, and 1320 nm 94.7%). For SSV, success rates at 6-weeks, 1-year, and 5-year of RF was 85.7%, 90%, and 75%, whereas, of 1320 nm was 100%, 88.2%, and 92.9%. The majority of treatments were performed with 1320 nm laser system which statistically demonstrated the highest Success rate. No DVT's were seen on DU.

**Conclusion:** A closure rate of more than 95% in GSV and SSV endovenous thermal ablatiive treatments was demonstrated. Over a decade, some recanalization was seen over time, however, a rate of 80% was maintained up to 13 years after procedure. For 1320 nm, excluding patients from the development phase, 95% long term success was noted.

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**#67**

**CLINICAL LONG-TERM (6 MONTHS) EPILATION USING A HOME-USE IPL FOR VARIOUS HAIR COLOR AND THICKNESSES**

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**Background:** Since the first laser was approved for long-term hair reduction by the FDA in 1995, laser, light and electro-optical removal of unwanted hair has grown to become the number one light-based aesthetic procedure. The aim of this ethics committee approved randomized study is to quantify short-term and long-term hair reduction using a novel, 7.6 J/cm², triple pulse, home-use IPL device.

**Study:** Ninety women meeting the eligibility criteria were enrolled in this ethics approved study. Subjects varied in age from 18 to 45 years of age, and skin types I–4. The Study group consists of two cohorts: 6 weekly treatments, with assessments at 1, 3 and 6 months post treatment. 6 weekly treatments with monthly treatments with assessment at 1, 3 and 6 months post treatment. Assessor-blind assessment of hair counts was made using custom computer software.

**Results:** Six months after the six week treatment, a 64% reduction in terminal hair count (P = 0.003) was recorded. No treatment related side effects were reported, with little or no discomfort reported during the treatment. 83% reported that the hair that did regrow was less noticeable due to being finer and or lighter.

**Conclusion:** Our study confirms that the at-home IPL device described in this study can be applied safely and effectively to reduce regrowth of unwanted hair.

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**#68**

**LONG-TERM HAIR REDUCTION WITH HOME-USE IPL DEVICES**

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**Background:** Over the last five years many different light-based hair removal devices have become available for home use, mostly based on IPL. Although the fluence of these devices is lower than professional systems, they usually do allow consumers to achieve a satisfactory level of hair removal and to maintain their hair reduction if used regularly. In this report we examine the safety and efficacy of several IPL devices and specifically the hair reduction after prolonged use.

**Study:** Four different commercially available home-use IPL devices were used on the armpits, bikini line and lower legs of 70 female volunteers in two study locations. Treatments were performed by a test leader to exclude variations from self-use. The regime consisted of four bi-weekly treatments followed by monthly maintenance treatments over a period of one year. Follow-up visits took place for one year after the last treatment. Photographs were taken at all treatment and follow-up visits for assessment of hair reduction.

**Results:** The hair reduction for the four different devices was comparable but not identical, ranging from 62% to 75% (lower legs) and 45% to 65% (armpits, bikini line) after the initial bi-weekly regime and from 65% to 80% (lower legs) and 55% to 70% (armpits, bikini line) after completion of the maintenance regime. Hair reduction remained at a high level for one year after the last treatment, ranging from 60% to 85% (lower leg) and from 50% to 60% (armpits, bikini line) at completion of the study. Only a few minor side effects occurred.

**Conclusion:** This study demonstrates that the home-use IPL devices we tested are generally safe and effective for hair removal and for maintaining the hair reduction under regular use. It also shows that hair reduction can remain at a high level for at least a year after conclusion of a prolonged treatment regime.

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**#69**

**A TWO-CENTER SAFETY AND EFFICACY CLINICAL STUDY WITH A NOVEL HOME-USE 1440 nm SKIN REJUVENATING LASER: A 3-MONTH EVALUATION**

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**Background:** An investigational 1440 nm non-ablative fractional diode laser was developed for consumer use in the treatment of tactile skin roughness, fine lines and wrinkles, and dyschromia. This study was designed to demonstrate safety and efficacy of the home-use laser device.

**Study:** Ninety subjects were enrolled in a prospective clinical study. Each subject was randomly assigned to one of three treatment levels (low, medium, high) ranging from 36 to 130 microbeams/cm² at 5 to 12 mJ/microbeam. Subjects self-treated their entire face daily at the study site for 12 weeks and were followed for 12 weeks after the final treatment. Tactile roughness was assessed weekly by the investigator. Periorbital wrinkles and dyschromia were assessed by a panel of 3 independent, blinded expert graders who scored standardized photographs. All assessments were performed utilizing 9-point scales. Tolerability and adverse events were monitored throughout the study.
RESULTS: Eighty-seven subjects completed the study. Twelve weeks post final treatment, mean tactile roughness scores improved by 2.4, 2.6, and 2.9 points (P < 0.001) for the low, medium, and high cohorts, respectively. Mean periorbital wrinkle scores improved by 0.6, 0.8, and 0.8 points (P < 0.001) for the low, medium, and high cohorts, respectively. Mean dyschromia scores improved by 0.4, 0.7, and 1.0 points (P < 0.001), for the low, medium, and high cohorts, respectively. Mild erythema, stinging, and warm or burning sensation were the most common adverse device effects experienced. In addition, mild hyperpigmentation was ongoing at study exit for 6 subjects. The mean tolerability score during the first day of treatment was 2.0 (out of 10) which steadily reduced to 0.6 by the last treatment.

CONCLUSION: The study showed that the consumer 1440 nm non-ablative fractional laser resulted in statistically significant and clinically meaningful improvement in tactile roughness, periorbital wrinkles, and dyschromia. Treatment was well tolerated and had minimal risk to participants.

#70

A CLINICAL AND PHOTOGRAPHIC EVALUATION OF AN AT-HOME 1440 nm SKIN REJUVENATING LASER

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BACKGROUND: Professional, non-ablative, fractional technology is a well-established modality for treatment of wrinkles and discoloration. An investigational 1440 nm, non-ablative, fractional, home-use device—which demonstrated histopathological profiles consistent with those created by professional devices—has been developed for the treatment of wrinkles and dyschromia. This study assessed the safety, efficacy, and satisfaction of participants performing full-face treatments with this device at home.

STUDY: Twelve females were enrolled in an open label study. Subjects performed daily treatments on their entire face for six weeks using treatment doses ranging from 36–260 microbeams/cm² at 5–12 mJ/microbeam and were followed for 4 weeks after the final treatment. A blinded dermatologist scored standardized high quality photos at baseline, 2 and 4 weeks post final treatment utilizing 9-point validated scales for periorbital wrinkles and dyschromia. Adverse events were monitored throughout the study.

RESULTS: Eleven subjects completed the study. Three subjects reduced their treatment regimen by stepping down to a lower treatment level, adding treatment holidays, or reducing the number of passes. At 2 weeks post final treatment, mean improvement scores for periorbital wrinkles and dyschromia were 1.0 ± 0.9 (P < 0.01) and 1.9 ± 1.6 (P < 0.01), respectively. At 4 weeks post final treatment, mean scores for periorbital wrinkles and dyschromia were 0.6 ± 0.9 (P < 0.01) and 1.1 ± 1.8 (P < 0.01), respectively. Most subjects (91%) were very to extremely satisfied with their treatments. The most common side effects were transient erythema, stinging/prickling, warmth or burning sensation, and dryness.

CONCLUSION: At-home full-face 1440 nm fractional laser treatments, with the flexibility to select different treatment doses, were well tolerated and produced statistically significant improvements in dyschromia and periorbital wrinkles. A majority of subjects were very to extremely satisfied with their treatment. At-home fractional laser treatments provide a viable and convenient alternative to in-office procedures.

#72

LOW DOSE HOME BASED LED THERAPY- CAN IT HAVE EFFICACY?

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BACKGROUND: Home based phototherapy for the treatment of cutaneous problems, such as acne and photoaging, can be achieved using a low power, daily use, LED-based ‘smart’ wearable mask, with significant efficacy, strong patient satisfaction, and a substantial safety profile, and can serve as an adjunct to existing products and procedures.

STUDY: 2 separate IRB approved single center clinical trials were performed over a 12 week period, evaluating the safety and efficacy of a home based LED mask in 60 patients for the treatment of acne and photoaging. After a 4 week washout period, multiple strips of LEDs utilizing various configurations of blue (440 nm), red (660 nm), and near infrared (830 nm), in a lightweight, wearable mask design, were worn for 10–15 continuous minutes per day for 8 weeks. The investigators recorded treatment data, including clinical physician analysis for acne counts and severity grading in the acne group, as well as facial aging parameters in the photoaging group. Standardized clinical photography was used, and patients filled out self-assessments, noting efficacy, satisfaction, and adverse events, at each clinic visit.

RESULTS: Statistically significant improvements (P < .001) were noted at week 8 for all clinical attributes, both for acne and photoaging. FDA Global Acne Severity score showed a 50% improvement, and median non-inflammatory and inflammatory lesion counts were decreased by 73.3% and 100% respectively. For photoaging, all clinical efficacy attributes, including skin radiance, roughness, pigmentation, and wrinkles, showed significant improvement. Patient compliance, satisfaction, and questionnaire grading were extremely favorable for both studies. There were no serious adverse events reported by the patients or physician investigators.

CONCLUSION: Phototherapy using LEDs as the light source have long been proven to be efficacious to treat a number of dermatological and aesthetic conditions. The phototherapy system used in these studies utilized an innovative mask design with a ‘smart’ wearable array, specifically positioned to maximize irradiance over the most common trouble zones, for both acne sufferers and photaged facial skin. Of particular note, treatment parameters were chosen to treat the issues in a ‘slow and steady’ fashion, using a relatively low powered device, but with a daily 10–15 minute regimen, as opposed to the more common, office based, high powered, short pulse width technique. In conclusion, LEDs are non-thermal, non-toxic, non-invasive, and safe, and are an ideal light source for the treatment of acne and photorejuvenation. The above studies utilized innovative wearable LED masks and a low power, daily treatment regimen to achieve its goals, noting statistically significant clinical improvement, very high patient satisfaction, and strong safety profile. We conclude that home based LED based phototherapy can be considered an inexpensive and effective option to add to our present armamentarium.

#73

EFFICACY, SAFETY AND DURATION OF BENEFIT FOR ITU (INTENSE THERAPY ULTRASOUND) HOME TREATMENTS

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TOPOCALLY APPLIED METHOTREXATE IS RAPIDLY ABSORBED INTO SKIN PROCESSED WITH ABLATIVE FRACTIONAL LASER


Background: Methotrexate (MTX) is a widely used systemic chemotherapeutic and anti-inflammatory drug, which may cause systemic adverse effects. The aim of this study was to investigate transport kinetics of topically delivered MTX in skin processed with ablative fractional laser (AFXL).

Study: In vitro passive diffusion of 10 mg/ml MTX (1 w/v%) was measured at 15 min, 1.5, 7, 18 and 24 h in Franz skin permeability cells (FC) (n = 6 samples per intervention). Mid-dermal laser channels (700 μm) were generated in porcine skin by 2,940 nm Er: YAG AFXL, spot size 225 μm, 2.4% density, 225 μs pulse duration, and 640 mJ/microchannel. High Performance Liquid Chromatography (HPLC) quantified MTX concentrations in FC-donor solutions, FC-receiver solutions and in skin cryo-sections at 500 μm depth. UVC-irradiation induced MTX-specific fluorescence (excitation: 405 nm/emission: 488 nm), which was used to visualize the biodistribution of MTX in skin sections by fluorescence microscopy. Biodistribution was further validated by Desorption Electrospray Ionization Mass Spectrometry Imaging (DESI-MSI).

Results: In AFXL-processed skin, the cutaneous MTX concentration increased significantly in the first 15 minutes after application (0.002% per 25 μm skin section, P = 0.031). Accumulation in the skin continued and reached a maximum plateau after 7 hours (0.03%, P = 0.031). Permeation across skin became significant at 7 hours of application (1.8% of applied MTX, P = 0.031) and reached a maximum plateau after 18 hours (8.6%, P = 0.031). In accordance, MTX concentration in the FC-donor decreased significantly from 0 to 15 minutes (94.3% of applied MTX, P = 0.031), followed by a steady decrease throughout the test period (81.5% at 24 h, P = 0.002). DESI-MSI confirmed the delivery of MTX and fluorescence microscopy illustrated distribution to the entire skin section.

Conclusion: After AFXL, topically applied MTX is rapidly delivered and restricted to the skin in a well-defined time period, which raises a clinical perspective for new treatments in dermatology.

ABSENCE OF INCREASED RISK OF NEURODEVELOPMENTAL DISORDERS IN CHILDREN UNDERGOING MULTIPLE LASER TREATMENTS OF VASCULAR ANOMALIES UNDER GENERAL ANESTHESIA

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Background: Recent reports suggest that before 4 years of age multiple exposures to general anesthesia may be neurotoxic to the developing brain. To date, no studies have examined the effects of general anesthesia on children undergoing multiple laser treatments for vascular anomalies. The purpose of this study is to evaluate the prevalence of neurodevelopmental abnormalities in children who received multiple laser procedures under general anesthesia before the age of 4 for the treatment of vascular anomalies.

Study: Retrospective review of eligible patients with contact of parent interviews. Questions included but were not limited to birth history, school performance, diagnoses of neurologic and psychiatric illnesses, and pertinent family history.

Results: Thirty-three patients were included in this study excluding those with Sturge-Weber syndrome. Average age of participants at time of survey was 7.8 years. Twenty-three (84.8%) of the 33 patients were female, with average age at time of first treatment at 1.9 years. The average number of treatments received before 4 years was 6.7. Fifteen (45.4%) children continued to be treated, and the majority (87.9%) was treated for port wine stains. The average length of the procedure was 15 minutes. 42.4% of the patients were female, with average age at time of first treatment at 1.9 years. The average number of treatments received before 4 years was 6.7. Fifteen (45.4%) children continued to be treated, and the majority (87.9%) was treated for port wine stains. The average length of the procedure was 15 minutes. 42.4% of the children underwent general anesthesia before the age of 4. Seven patients carried one or more of the following diagnoses: ADHD (3.0%), anxiety (6.1%), behavioral problems (3.0%), language delay (3.0%), speech problems (3.0%), motor delay (6.1%). The prevalence rates of these conditions are statistically
similar to those of the general U.S. population ($P > 0.05$). Seven (21.2%) children had a family history of neurodevelopmental abnormalities.

**Conclusion:** This is the first report on the prevalence of neurodevelopmental disorders in children undergoing multiple laser treatment under general anesthesia for vascular anomalies. No increased risks when comparing to prevalence rates reported in the literature were noted.

**#76**

**MAUDE DATA ON COMPLICATIONS WITH LASER AND LIGHT-BASED DEVICES**

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**Background:** It is essential for physicians to be consistently informed of device adverse events and device malfunctions that occur in routine practice among all practitioners. More knowledge is needed than what is provided from initial device studies and reports in the medical literature by physicians in the field. The FDA requires that manufacturers and device users submit medical device reports (MDRs) for suspected injuries from device use or malfunction. The FDA also collects voluntary reports from patients. The database of MDRs, entitled Manufacturer and User Facility Device Experience (MAUDE) allows the FDA to monitor patient safety issues. This database is an untapped reference that can be useful for evaluating the adverse events associated with laser devices.

**Study:** We employed the following search strategy to identify reported adverse events: in October 2013, we searched the MAUDE electronic database on the FDA website: http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfmaude/search.cfm. We collected all reported cases between 1991 and September 2013. The search terms utilized included a comprehensive list of both device manufacturers and specific product names.

**Results:** Our search yielded 1500+ MDRs. All cases were included, except for few instances of patients reporting inefficacy of home use devices. The data is broken down into the adverse events seen, such as, but not limited to blistering, scarring, dyspigmentation, or malfunction of cooling. The cases describe the adverse event and the determination if it was a device malfunction or an issue with the operator of the device.

**Conclusion:** Over one thousand MDRs have been reported to the FDA and physicians should be aware of the reported events and malfunctions of the devices used in dermatology. This database will help uncover otherwise unreported events seen in routine practice among all types of practitioners. In addition, this knowledge will allow us to better inform our patients on these devices.

**#77**

**ANALYSIS OF SHORT PULSE LASER BASED THERAPEUTIC APPLICATIONS FOR SOFT TISSUES**

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**Background:** Short-pulse lasers with pulse duration in the order of nanoseconds and shorter offer the advantage of targeted heating of tissues as the duration of heat delivery is smaller than the thermal diffusion time of the tissue. The objective of this paper is to analyze the spatiotemporal temperature distribution in skin tissues considering embedded vasculature due to short pulse laser irradiation.

**Study:** A three layer skin tissue was created in SolidWorks. Unlike previous models in literature, vasculature has been included in the geometry in the form of countercurrent venule-arteriole pairings ingrained in the tissue. Thermal transport due to short-pulse laser irradiation on the tissue was simulated using COMSOL Multiphysics which uses finite element analysis to solve the Pennes' bio-heat transfer equation in the tissues coupled with fluid flow and heat transfer in the blood vessels. The results of the simulations were validated by irradiating live anesthetized mouse with a focused beam from a short-pulse Nd:YAG laser source having a wavelength of 1064 nm and a pulse width of 200 ns. Histological analysis has been performed to analyze the heat affected zone due to laser irradiation.

**Results:** When the laser was focused at a depth below the surface of the skin tissue, the experimentally determined average temperature rise in the tissue after 10 seconds was 105% at the focal depth, whereas the average rise below the focal depth and at the skin tissue surface was 46% and 27%, respectively. A detailed parametric study was conducted to compare the temperature rise at the laser focal point and in the surrounding tissue with and without embedded vasculature geometries, against experimental findings.

**Conclusion:** Inclusion of embedded vascularity plays a significant role in the computational analysis of short-pulse laser based therapy of soft tissues. This technique has further applications in areas such as skin tissue burn and hyperthermia studies.

**#78**

**MECHANISMS AND CHARACTERISTICS OF FRACTIONAL LASER ABLATION CRATER DEVELOPMENT**

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**Background:** Ablative fractional lasers are widely used in dermatology. Formation of an ablation crater is affected by various laser parameters. Aim of this study was to quantify the dynamic mechanical effects in relation to various parameters of ablative fractional lasers. Descriptive results have partly been presented at the ASLMS annual conference in 2011. We now present the results of quantitative measurements of ablation crater characteristics and discuss the consequences from a clinical point of view.

**Study:** We conducted a series of comparative experiments with a CO$_2$, an Er:YAG and an Er,Cr:YSGG laser. The dynamic effects of variations in pulse duration, pulse energy and spot size on the formation of ablation craters were assessed in polyacrylamide gel using a high speed camera. Depth and width of fractional ablation craters were measured by digital image analysis using Adobe Photoshop CS5.

**Results:** Short pulse durations and high pulse energies led to the formation of deep and narrow ablation craters. At short pulse durations (<500 is) an explosive vapor bubble was observed that can be >4 times as wide as the final ablation crater. Differences between the Er:YAG and Er,Cr:YSGG laser were minimal, when using the same settings. The use of a 400 im spot led to an ablation...
crater that was 1.5 times narrower than the crater produced by a 200\(\mu\)m spot, when irradiating at 60 is pulse duration.

**Conclusion:** Variations in pulse duration, pulse energy and spot size have significant effects on fractional ablation crater characteristics. With short pulse duration, mechanical distortion of tissue, e.g. collagen or vascular structures may occur, possibly leading to scarring or bleeding. Larger spot sizes give narrower ablation craters depending on pulse duration. As certain indications, e.g. laser assisted drug delivery, may require specific crater characteristics, these data may help clinicians in their choice of optimal laser settings.

### #79

**ROLE OF BEAM SHAPE & SPOT SIZE IN HEATING TARGETS AT DEPTH**

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**Background:** A small-area adaptor is used to (a) enhance lesion targeting and (b) reduce exposure of uninvolved skin. Reducing the spot size of a device, however, introduces tradeoffs. Energy absorbed by a target is determined by depth of the target and in situ beam spatial characteristics and spot size. An in vitro skin study and simulations compared heating of a target at depth versus spot size using a diode laser. Clinical results with a 4 mm adaptor for two IPLs are also provided.

**Study:** Porcine skin and fat tissue were separated to form a 3 mm skin layer above a 1 cm fat layer. A 50 mm thermocouple was placed between the layers. An apertured 23 × 38 mm treatment window of an 805 nm diode laser device (Vectus\textsuperscript{TM}, Cynosure) provided various incident beam spot sizes and the temperature rise of the thermocouple was measured for fixed fluence. Over 20 patients were treated for pigmented and vascular lesions. Device fluences ranged from 30 to 80 J/cm\(^2\) and pulse durations ranged from 20 to 100 ms. Fifteen patients were treated once and followed 1–2 months after treatment.

**Results:** Simulations showed a beam divergence of 50' (Full Width at Half Maximum) in porcine skin that includes scatter and beam divergence in air. The temperature rise versus treatment area exhibits two regimes with different slopes. The first regime (area <1 cm\(^2\)) has a higher slope than that for the regime (area >1 cm\(^2\)). The slope of the second regime is appreciable and provides a fluence reduction factor for skin safety. The same temperature rise in a target at 3 mm depth is realized by increasing area 4 × while reducing fluence by half. Clinically, Higher fluences (30–50\%) were required for both pigment and vascular targets with the small spot adapter compared with the 10 × 15 and 12 × 28 mm IPLs because decreasing efficacious fluence is realized only for spot sizes ~10 mm and greater. Otherwise, energy determines efficacy. The adapter provided precise visualization and targeting. Long pulse durations (100 ms) achieved closure of vessels up to 1.3 mm in diameter. Darker and lighter lentigines required 30 J/cm\(^2\) and 54 J/cm\(^2\) (20 ms) respectively for immediate darkening and subsequent desquamation and clearing. The increase in the adaptor’s threshold fluence for epidermal damage was greater than expected. Modeling demonstrates that some of this discrepancy is attributable to backscattering losses.

**Conclusion:** The role of spot size and in situ beam divergence is an important consideration to determine optimum fluence settings that increase skin safety when treating deeper targets. The small footprint reduces pain, increases target visibility and avoids treating healthy skin surrounding lesions with areas much less than 1.5 cm\(^2\). The protruding light guiding cylinder also allows for easier and more comfortable treatment on highly contoured areas (near nose, on ears, edge of lips) where larger optic skin contact could be compromised.

### #81

**DUAL-MODALITY ENDOSCOPIC IMAGING OF CANCER IN MOUSE COLON**

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**Background:** The accepted model of colorectal cancer progression is a linear development from normal colon to adenoma to carcinoma. However, it has been proposed that changes in crypt patterns precede the formation of a polyp. While a correlation has been found between these changes and the presence of adenoma, a causal relationship has yet to be determined. A non-destructive in vivo imaging method may be used to track the development of adenoma from normal colon over time and elucidate this relationship.

**Study:** We built a dual-modality endoscope that combines fluorescence-based surface magnifying chromoendoscopy (SMC) and optical coherence tomography (OCT) to image the colon. Sixteen mice were treated with the carcinogen azoxymethane to induce tumor development in the distal colon and imaged once a month for up to six months. Methylene blue was used as a contrast agent for SMC. At the final time point, the colon was explanted, opened, and imaged with table-top reflectance and fluorescence microscopes. Samples were then fixed for histology.

**Results:** Our lab previously demonstrated that OCT can detect adenoma, both number and size, in the mouse colon with high sensitivity and specificity. SMC images clearly show changes in fluorescence signal and spatial distribution from normal colon to medium and large adenoma. Normal areas exhibit regularly spaced crypts of equal size, forming either a dot or honeycomb pattern. SMC images of small to medium adenoma exhibit larger crypts, more intense signal, and irregular spacing; large adenoma have heterogeneous and intense fluorescence and loss of crypt structure. We correlate intensity in SMC images with adenoma and precancerous locations generated from OCT and histology.

**Conclusion:** We have built an endoscope that is capable of systematically interrogating the entire colon. By combining SMC with OCT, we are able to correlate the mucosal alterations with the subsurface architectural changes.

### #82

**CONFOCAL MICROSCOPY TO GUIDE LASER ABLATION OF BASAL CELL CARCINOMA**

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**Experimenal and translational research**
Background: Ablative lasers have been utilized to treat non-melanoma skin cancers (NMSC), however, no tissue is available for post-histological analysis. We show proof of principle utilizing confocal microscopy to guide ablation and identify clearance of NMSC.

Study: After IRB approval, discarded tissue from Mohs surgery was imaged using a Vivascope 1500 (Caliber Imaging and Diagnostics, formerly, Lucid Inc.) confocal microscope with 850 nm illumination to identify basal cell tumor and guide ablation. For imaging of residual BCC in ablated tissue acetowhitening. The tissue was ablated with an ultrapulsed Carbon dioxide (CO2), using varying parameters of fluence and passes. Dog ear discard tissue was also treated as a control. Post ablation the tissue was then reimagined to detect any presence of tumor and then the tissue was probed by frozen sections stained with H&E to confirm ablation histologically.

Results: Seventeen Mohs tissue samples containing BCC were imaged and ablated. The ultrapulse CO2 laser operating at 10.6 μm was used with computer pattern generator mode and size pattern of 3 mm. Fluence ranged from 5 to 12.50 J/cm2 and the number of passes ranged from one to four. The pre-imaging was able to identify tumor islands and post-imaging showed areas of ablated tissue. Ablation correlated with confocal images showing cellular structural changes and loss of tumor islands and confirmed on frozen sections. In both the confocal imaging and frozen section, the epidermis and tumor were shown to be ablated but parts of the dermal epidermal junction were still intact. An ablation depth of 100 microns (confirmed with frozen sections) was achieved.

Conclusion: We have shown the feasibility to detect residual BCC in post-ablated tissue with RCM imaging. The results illustrate the potential of utilizing confocal imaging to guide laser ablation of BCCs. This investigation will lead into a long-term study that will focus on optimization of ablation parameters (fluence, number of passes, choice of laser and wavelength) for minimal thermal damage, development of a safe and effective contrast agent for use on patients, optimization of labeling parameters (concentration, time) especially for detection of discrete tumors. Clinical studies will involve in-vivo testing for efficacy of ablation and tumor recurrence relative to the standard of care.

#83

OPTICAL MARKERS THAT DISTINGUISH BENIGN MELANOCYTIC NEVI IN VIVO: A MULTIPHOTON MICROSCOPY STUDY

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Background: Multiphoton microscopy (MPM) is a laser-scanning microscopy technique that relies on non-linear light-matter interactions such as two-photon excited fluorescence (TPEF) and second harmonic generation (SHG) to achieve 3D images with sub-micron resolution. In MPM, the main sources of fluorescence are reduced nicotinamide adenine dinucleotide (NADH), flavin adenine dinucleotide (FAD), keratin, melanin, and elastin fibers while collagen is the main source of SHG signal. This presentation will focus on both qualitative and quantitative analysis of in-vivo microscopy images acquired from lesions diagnosed as common nevi, atypical nevi or melanoma.

Study: Imaging was performed with a clinical laser-scanning MPM-based tomograph (MPTflex, JenLab GmbH, Germany). We analyzed the MPM images corresponding to 15 lesions (5 in each group) both qualitatively and quantitatively. The qualitative analysis involved identifying morphological features of the lesions in the three groups and correlating MPM with histologic features. The quantitative analysis was based on TPEF and SHG derived from 3D MPM image analysis.

Results: Morphological changes imaged with MPM such as cytological atypia, lentiginous hyperplasia and appearance of nests of nevus cells on the sides of the rete ridges correlate well with histology. These morphological changes are also associated with variations in the TPEF and SHG signals. We defined a numerical “multiphoton melanoma index (MMI)” based on quantitative TPEF, SHG, and density of melanocytic dendrites in the upper epidermal layers. We show that the quantitative MMI scores corresponding to each group are significantly different from the scores in the other two groups.

Conclusion: These findings suggest that both qualitative and quantitative characteristics can be used to help guide further investigation of a larger number of patients in order to validate the proposed MMI scoring algorithm and evaluate the potential of MPM technology to distinguish dysplastic nevi from common nevi and melanoma.

#84

DYNAMIC IN VIVO OPTICAL RESOLUTION PHOTOACOUSTIC MICROSCOPY OF HUMAN SKIN WITH AN IMPROVED DEPTH RANGE

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Background: Recent development of optical resolution PAM (OR-PAM) demonstrated excellent microvasculature functional imaging in small animal models with cellular level resolution, 1–2 millimeter imaging depth, and significantly reduced laser pulse energy. The tightly focused OR-PAM laser increased both the photoacoustic (PA) signal and the laser illumination area on the skin surface. In vivo human skin imaging results from our previous OR-PAM imaging probe showed that the highly scattering human skin tissue and limited Rayleigh range of the tightly focused laser beam contributed to an imaging depth that was less than the preclinical result. In this work, we report an innovative OR-PAM imaging probe that images in vivo human skin microvasculature with an improved depth range.

Study: To effectively increase the imaging depth range without sacrificing imaging signal-to-noise ratio, we adopt a dynamic approach. Two excitation laser beams with different wave-front curvatures were focused at two subsurface locations. By switching between two excitation laser beams between A-line images, we can synthesize an A-line image from two neighboring A-lines without overlapping the two excitation laser beams in time. The synthesized A-line image exhibits an improved imaging depth range.

Results: We manufactured a miniature OR-PAM imaging probe with dual excitation laser beams. Although the mass of the probe is 130 grams, our mechanical stage still can sustain 20 frames/s B-scan imaging speed. ZEMAX simulation results demonstrated its lateral resolution of 3 μm and doubled effective Rayleigh range. Signal-to-noise ratio (SNR) is not sacrificed due to the
CHARACTERIZATION OF SUBSURFACE BLOOD FLOW USING LASER SPECKLE IMAGING

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Background: Researchers use laser speckle imaging (LSI) to quantify the relative speed of dynamic light scatterers in tissue. Speckle contrast values contain contributions from both static and dynamic scattering objects. The impact of these contributions depends on the processing algorithm used. Researchers typically calculate speckle contrast by quantifying either spatial or temporal variations in the speckle pattern. We hypothesize that contrast values calculated with the temporal algorithm are less sensitive to contributions from static scatterers.

Study: We infused Intralipid solution into a tube at flow speeds of 3–18 mms, to simulate the dynamic scattering of blood. We placed epidermal phantom present demonstrate the addition of a static overlying static scattering component. We used LSI with an 808 nm laser and cooled CCD camera, at exposure times ranging from 60 μs to 30 ms, to collect raw speckle images, and calculated speckle contrast images.

Results: We observed that the spatial contrast increased by 31% and 82% on average after placing a 310 and 1000 μm epidermal phantom above the exposed tube and imaging with a 1 ms exposure time. From the same data set, we observed only a 6% and 8% change on average with the use of the same epidermal phantom and temporal processing algorithm. Furthermore, contrast versus exposure time plots of the data taken with an epidermal phantom present demonstrate the addition of a static component in the spatially processed data, in accordance with a previously published multi-exposure speckle contrast equation.

Conclusion: Based on the experimental data, we conclude that the temporal processing algorithm for LSI is considerably less sensitive to static scattering and enables quantization of blood flow dynamics at depths as great as 1 mm. Therefore, we believe the temporal LSI algorithm is more accurate at assessing subsurface perfusion in the presence of static scatterers in tissues such as skin or teeth.

A CLINICAL AND HISTOLOGIC STUDY OF SKIN TREATED WITH A PICO-SECOND ALEXANDRITE LASER COMPARING A UNIFORM TREATMENT SPOT AND A SPATIALLY MODULATED SPOT

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Background: When treating tattoos with this device we have observed blistering and crusting in tattoo and normal adjacent skin. This observation as well as the recent development of a diffractive lens array for the treatment for acne scars and photo-rejuvenation prompted us to study the clinical and histologic effects of both modalities on skin.

Study: Patients had non-facial areas of normal skin treated. A single pass with 1.3–4.1 J/cm² was performed with the uniform spot lens and 3 passes at 0.7 J/cm² were performed with the diffractive lens array. At 24 hours, 3.5 mm punch biopsies were taken for histology. Photographs were taken and skin typing, melanin indexing (MI), and tanning were recorded.

Results: Clinically, sites treated with uniform spot lens were observed to have faint erythema at lower fluences and superficial crusting and erythema at the higher fluences 24 hours after treatment. Transient post-inflammatory hyperpigmentation was observed in patients with darker skin types and higher MI. Microscopically, a dose incremental necrosis and liquefaction of keratinocytes was observed. Treatment with the diffractive lens array demonstrated mild erythema lasting approximately 24 hours. Histologically, scattered areas of liquefaction were demonstrated only in the epidermis co-located with pigmented granules stained for melanin. A superficial perivascular infiltrate was also observed with both lenses. All responses were dependent on skin typing, tanning and MI.

Conclusion: These observations suggest that there is significant absorption of laser light by melanin leading to injury to collateral epidermal cells. The extent of injured sites appears to be both dose and pigmentation dependent as reflected by skin typing, tanning, and MI. The diffractive lens array light delivery modality appears to selectively damage localized regions in the epidermis with a good safety and side effect profile.
since a lower power is delivered over the same target area, the risks of collateral damage can also be reduced.

#88

COMPARISON OF 532 nm KTP AND 595 nm PDL IN THE TREATMENT OF ERYTHEMATOUS SURGICAL SCARS: A RANDOMIZED, CONTROLLED, OPEN-LABEL STUDY

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Background: The pulsed dye laser (PDL) has long been used for treatment of erythematous and hypertrophic scars. Its effectiveness has been attributed in large part to its vascular-specificity. The vascular-specific KTP laser has also been reported to be clinically effective for scars, but has not been specifically studied for this purpose. Objective: To compare the safety and clinical efficacy of a 532 nm KTP laser versus a 595 nm PDL in improving the appearance of erythematous surgical scars.

Study: 20 patients with matched bilateral erythematous surgical scars or a single linear erythematous scar measuring longer than 5 cm were enrolled in the study. Only patients with skin phototypes I–IV and scars less than 24 months post-surgery were included. Single scars were divided into equal halves with each half randomized to receive 3 successive treatments at 6 week intervals with either a 532 nm KTP laser (Excel V, Cutera) or a 595 nm PDL (Cynergy, Cynosure) at equivalent laser parameters. Bilateral matched scars were similarly randomized to receive three 532 nm KTP or 595 nm PDL treatments. Clinical efficacy was evaluated 12 weeks after the third (final) laser treatment by independent photographic scar assessments. The physician assessors were blinded to the study protocol. Secondary evaluations included final investigator and subject treatment/satisfaction assessments, subject scar symptoms, intraoperative pain assessments, subject scar symptoms, intraoperative pain scores, as well as side effects.

Results: Clinical improvement of erythematous surgical scars was seen with both 532 nm KTP and 595 nm PDL systems in all study subjects. Side effects were limited to mild treatment discomfort and minimal transient post-treatment erythema and purpura. No vesiculation, infection, scarring or other adverse events were experienced. Subject satisfaction surveys mirrored the observed clinical effects.

Conclusion: The 532 nm KTP laser is comparable in efficacy and safety with the 595 nm PDL laser for the treatment of erythematous surgical scars.

#89

PERCUTANEOUS LASER DISC DECOMPRESSION: INFLUENCE OF DIFFERENT WAVELENGTHS OVER DISCAL LESIONS

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Background: Laser discectomy or nucleotomy or percutaneous laser disc decompression (PLDD) is an increasingly important method in less invasive procedures of column, but the ideal laser is still a matter of study. Objectives: to investigate the action of the laser emission in the infrared (808–1908 nm) region in the context of surgical procedures for percutaneous intervertebral disk decompression (nucleotomy).

Study: 50 intervertebral discs of the lumbar spine of pigs were irradiated with laser (wavelength = 808, 980, 1470 and 1908 nm), with one-second on/off time cycles, 120 cycles and 10 W of power (808, 980 and 1470 nm) or 240 cycles and 5 W (1908 nm) with total power of 1200 J and subjected to microscopic evaluation by Hematoxylin-Eosin (HE) for measurement of thermoablation lesions and residual thermal lesions.

Results: The measures of the ablation lesions were 1.08 ± 1.25, 1.70 ± 0.63, +1.02, +0.39 and 1.37 ± 0.94 ±0.41 mm (median ± SD) respectively for the control group, 808, 980, 1470 nm and 1908 nm laser groups. The residual thermal injury was less evident in 1908 nm laser and broader in 980 nm laser.

Conclusion: The laser at the 1908 nm wavelength was more efficient, followed by the wavelengths of 1470, 808 and 980 nm for the vaporization of the nucleus pulposus and proved to be recommended for laser nucleotomy procedures.

#90

MANAGEMENT OF SIMPLE OBESITY BY USING LASER ACUPUNCTURE AND TRADITIONAL CHINESE ACUPUNCTURE

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Background: Obesity is not only a cosmetic issue it is a chronic complex condition, with associated co-morbidities. Obesity simply is a condition of abnormal or excessive fat accumulation in the body associated with increased risk of illness, disability that may impair health, and led to death. Laser acupuncture therapy is the result of melding 21 Century low-level laser technology with the Ancient Chinese Acupuncture.

Study: Controlled placebo single blind. 73 obese women aged 18-45years, BMI > 25 were randomly divided into three groups according to management procedure Group 1 laser acupuncture, Group 2 needle acupuncture, and Group 3 Sham (placebo). All subjects prescribed low caloric diet and physical training exercise program. Anthropometric measurements (WT BMI, HC, WC, SF thickness) and Serum leptin level were measured using ELISA technique before and after treatment. Acupuncture (needle or laser) sessions were done once/week for 3 months using disposable filiform needle for needle therapy and portable semiconductor laser for low level laser therapy. Acupuncture points were chosen according to the theory of Chinese Medicine and WHO standard (27 acupoints).

Results: There was a significant reduction in body weight, BMI, WHR, and sum of skin folds (P < 0.0001) in the three groups with mean difference more in group 1, and group 2 comparing with group 3. There was a significant reduction in fat percentage (P < 0.0001) in the three groups with mean difference (2.2 ± 0.8) in group 1 (1.5 ± 0.5) in group 2 and (0.6 ± 0.2) in group 3. Serum leptin showed significant decrease in all groups with mean reduction difference more in laser group (22 ± 8) and needle group (7 ± 5) compared to control group (1 ± 5).

Conclusion: Compared with classic needle acupuncture, laser acupuncture manifests many advantages in management of simple obesity regarding the mean reduction difference in all the anthropometric measurements and the degree of serum level of leptin reduction.
SUBCUTANEOUS TISSUE RESPONSE BY HYPERTHERMIC TREATMENT USING A 1060 nm LASER

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Background: Past studies on various types of tissues exposed to hyperthermic temperatures have demonstrated effects on cell viability. The purpose of this study is to (1) demonstrate the feasibility of utilizing a 1060 nm diode laser to establish a controlled hyperthermia temperature in subcutaneous tissue, (2) evaluate the acute and long term subcutaneous tissue response to a hyperthermia treatment through histological analysis.

Study: Sixteen subjects were recruited to receive a laser treatment on the abdomen prior to their scheduled abdominoplasty. In vivo tissue temperatures during laser radiation from 4 subjects were measured using a thermal camera and a thermocouple to confirm the temperature profile with titrated treatment parameters. Tissue specimens of these 4 subjects were taken immediately post treatment to evaluate acute tissue response. The remaining 12 subjects were treated with different dosages and follow up schedule based on the results of the 4 subjects. Tissue histology (H&E Staining) was analyzed at multiple follow-up times from 3 days to 6 months.

Results: Both the optical-thermal analysis and tissue temperature tests confirmed that a hyperthermic temperature (42–47 °C) can be achieved in subcutaneous tissue while maintaining skin temperature below 30 °C. The clinical and histological evaluations of subjects treated with various laser dosages suggested safe and effective treatment parameters: exposure duration 20–25 minutes, radiant exposure approximately 2.0 W/cm² and laser duty cycle 66–70%. Tissue specimens taken from day 0 to 6 months showed evidence of adipocyte damage starting at 1 week post treatment and adipose tissue healing through phagocytosis up to 6 months. Treatments were well-tolerated by all subjects with no side effects to skin at any tested dosage.

Conclusion: The temperature measurements and clinical and histological evaluations of in vivo tissue response to a hyperthermic temperature (42–47 °C) treatment suggests that this 1060 nm laser system can be used for subcutaneous fat reduction.

USE OF A MELANIN READER TO COMPARE TANNED AND UN-TANNED SKIN RESPONSE TO IPLS

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Background: Pigment meters are playing an increasing role in cosmetic dermatology. In particular, devices that provide a measure of skin melanin have been combined with treatment systems to aid in parameter selection and increased safety. This study compares skin reaction of tanned and untanned skin with MI.

Results: All threshold fluence values occurred at or above the recommended maximum fluence range versus MI provided by the system. A paired Student t-test showed no statistical difference in threshold fluences between tanned and untanned skin at similar MI values (P > 0.12). A linear regression analysis showed greater sensitivity of untanned skin threshold fluence with MI (<1.2 J/cm²/MI vs 0.4 – 1.2 J/cm²/MI). Finally, the fluence ranges provided by the system’s algorithm for each MI never encompassed the observed threshold fluences for either skin condition.

Conclusion: Skin reaction to IPL treatments is dependent on MI but no significant dependence on tanned versus untanned skin is seen. The system’s Skintel fluence range was safe for both skin conditions. This study suggests the need for further investigation into the role of tanning and MI measurements. Ethnicity and anatomical sites were ignored in the analysis.

ERBIUM LASERS APPRECIATED FOR VARIOUS MEDICAL APPLICATIONS BY UNDERSTANDING THE MECHANICAL AND THERMAL INTERACTIONS IN TISSUES

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Background: Erbium lasers have been mostly applied in dermatology and dentistry due to their assumed non-thermal ablation of both soft and hard tissues. However, the unique characteristics of Erbium lasers can be considered for a large range of medical applications especially with new fibers enabling endoscopic delivery.

Study: Based on insights from earlier studies, the mechanical and the thermal interactions of Erbium lasers were studied using special imaging methods in different tissue types and physiological environments simulating conditions for various medical applications. Biological and model (gel) tissues were exposed in an air or water environment with Erbium lasers simulating medical applications like stapedectomy (ENT), stricture ablation and lithotripsy (urology), cartilage shaping (orthopedics), liposuction (dermatology), root canal treatment (dentistry).

Results: Various laser settings were compared: Er:YAG (2.94 μm) and Er:YSGG (2.78 μm), pulse lengths 60–700 μs, pulse energy 10–100 mJ, fiber tip shapes flat and tapered. The thermal interaction was imaged with 100 μs resolution (1000 fps) showing fast thermal relaxation and mechanical interaction was imaged with 5 μs resolution showing explosive ablation, vapor bubble dynamics and cavitation effects. Thermal effects only contributed in confined spaces or at high repetition rate of pulses. Mechanical effects were significantly enhanced in a fluid environment by high speed water streaming and jet formation induced by expanding and imploding vapor bubbles. A newly developed method showed pressure waves propagation at speeds >5 m/s.

Conclusion: Special imaging methods provided to good understanding of thermal and mechanical interactions of Erbium lasers for a range of medical applications contributing to the optimal laser settings and safety limits especially in a water environment.
#94

SELECTIVE THERMAL ABLATION OFATHEROSCLEROTIC PLAQUE BY HIGH POWER QUANTUM CASCADE LASER IN THE 5.7 MICROMETER WAVELENGTH RANGE

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Background: Laser angioplasty is suitable for difficult-to-treat lesions. However, conventional excimer laser have the risk of injuring normal vessels. Therefore, safer laser devices have been required. Atherosclerotic plaques consist mainly of cholesteryl esters. Irradiation with a wavelength of 5.75 μm is strongly absorbed by the CO stretching vibration mode of cholesterol esters. Awazu et al. reported the possibility of selective treatment of atherosclerosis using a free electron laser and a laser by difference-frequency generation with the wavelength. For applying this technique, compact laser is required. Quantum cascade laser (QCL) is recently developed semiconductor laser that can emit in the mid-infrared range. In this study, irradiation effects of a compact and high power QCL in the 5.7 μm wavelength range to atherosclerotic and normal aortas were investigated and the efficacy for less-invasive laser angioplasty was evaluated.

Study: An atherosclerotic thoracic aorta was resected from a myocardial infarction-prone Watanabe heritable hyperlipidemic rabbit (WHHLMI rabbit) provided from Institute for Experimental Animals, Kobe University Graduate School of Medicine and a normal thoracic aorta was resected from a Japanese white rabbit. They were cut into pieces of about 5 × 5 mm². The pulse width and repetition rate of the QCL were 500 ns and 1000 kHz, respectively. The average power density and the irradiation time respectively varied in the ranges 120–180 W/cm² and 1–10 s, respectively.

Results: The ablation of atherosclerotic aorta was observed for 1 s and over at 180 W/cm², while that of the normal aorta was observed over 10 s. The increase in ablation depth with thermal side effects became moderate as the irradiation time was increased.

Conclusion: The QCL achieved the selective ablation of the atherosclerotic lesions and it indicates the potential for less-invasive laser angioplasty. For more effective ablation of the lesions, reducing thermal effects by improving the irradiation condition is required.

#95

PRECLINICAL IN VIVO EVALUATION OF VASCULAR TARGETED NARROW BAND INTENSE PULSED LIGHT IRRADIATION ON NORMAL VASCULATURE

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Background: Pulsed-dye laser (PDL) therapy is the gold standard for treatment of port wine stain (PWS), but complete removal is infrequently achieved. Similar to PDLs, Intense Pulsed Light (IPL) devices are designed based on the concept of selective photothermolysis, but they instead use incoherent broadband light to affect the targeted chromophore. In this study, we investigated the microvascular effects of vascular-targeted narrow-band (500–600 nm) IPL and PDL irradiation.

Study: We performed experiments on the mouse dorsal window chamber (n = 18). We used laser speckle imaging (LSI) to monitor blood-flow dynamics. With the PDL (595 nm, 1.5 ms pulse duration), we used radiant exposures between 3 and 10 J/cm². With the narrow-band IPL, we used radiant exposures of 7–15 J/cm² and pulse durations of 3–5 ms, and we studied the microvascular effects of both single and multiple IPL pulses. In this study, we defined a successful treatment outcome as persistent vascular shutdown, using LSI, achieved seven days following irradiation.

Results: With the PDL, we observed persistent vascular shutdown at 7 J/cm². For single-pulse experiments, we observed persistent vascular shutdown with 12 J/cm² and 3 ms pulse duration. For double-pulse experiments, we observed a reduction in irradiance required to achieve persistent vascular shutdown. We identified specific classes of responses in the IPL treatments: no vascular shutdown, acute vascular shutdown, using LSI, achieved seven days following irradiation.

Conclusion: Our preliminary data suggest that the vascular targeted narrow-band IPL may be an effective device for treatment of PWS.

#96

THREE DIMENSIONAL VOLUMETRIC QUANTIFICATION OF FAT LOSS FOLLOWING CRYOLIPOLYSIS

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Background: Cryolipolysis is a non-invasive treatment for reduction of localized subcutaneous fat. Although studies demonstrate the safety and efficacy of this procedure, volumetric fat reduction from this treatment has not been quantified. This prospective study investigated the change in volume of fat after cryolipolysis treatment using three-dimensional (3D) photography.

Study: A prospective study of subjects treated with cryolipolysis on the flank was performed at Massachusetts General Hospital. Volume measurements were performed with a Canfield Scientific Vectra 3D camera and software to evaluate the amount of post procedure volume change. Clinical outcomes were assessed with caliper measurements, subject surveys, and blinded physician assessment of photographs.

Results: Eleven subjects were enrolled in this study. Each subject underwent a single cycle of cryolipolysis to one flank. The untreated flank served as an internal control. The follow up time after treatment was two months. The mean amount of calculated absolute fat volume loss using 3D photography from baseline to 2 months follow up visit was 56.2 ± 25.6 cc from the treatment site and 16.6 ± 17.6 cc from the control (P < 0.0001). A mean absolute difference of 39.6 cc between the treated and untreated sides was calculated at 2 months post-treatment. Comparison of caliper measurements from baseline to 2 months post-treatment demonstrated significant reduction of the treated flank from 45.6 ± 5.8 mm at baseline to 38.6 ± 4.6 mm at 2 months post-treatment (P < 0.001). The untreated flank did not show significant reduction with caliper measurements. No unexpected side
High intensity focused ultrasound (HIFU) is a non-invasive method for body sculpting. HIFU raises the temperature of a focused area within the subcutaneous adipose tissue (SAT), producing cell necrosis in adipocytes and contraction of collagen. The focused-depth nature of the HIFU technique allows localized destruction of SAT without damage to the surrounding tissues. This randomized, controlled study was performed to evaluate the clinical efficacy of HIFU treatment for circumferential thigh reduction.

**Study:** Sixty subjects received a single HIFU treatment (Liposonix®, Solta Medical, Hayward, CA) on one randomly assigned thigh under IRB approval. HIFU treatment was performed using a total fluence between 140 and 180 J/cm². The opposite thigh was not treated and served as a control for each subject. Subjects returned for efficacy assessments at 1, 4, 8, and 12 weeks following treatment. Primary efficacy was assessed 12 weeks after treatment using thigh circumference measurements. Secondary outcome measures included investigator and subject improvement scores.

**Results:** The least square mean reduction in circumference of the treated thigh (~1.22 cm) was significantly greater than the change in the untreated control thigh (~0.59 cm) at 12 weeks (P = 0.007). There was also a statistically significantly greater reduction in thigh circumference in the treated thigh versus the change in the control thigh at both the 4 week (P = 0.038) and 8 week (P = 0.0059) follow-up visits, with reductions increasing over time. Investigators rated 79% of subjects as improved or much improved and 74% of subjects rated themselves as improved or much improved at the 12 week visit. Fifty-seven percent of subjects were satisfied or very satisfied with treatment results at 12 weeks. No serious adverse events were observed or reported.

**Conclusion:** The results of this study demonstrate that HIFU treatment is effective for circumferential reduction of the thighs by treatment of the SAT. A highly statistically significant reduction in thigh circumference from baseline on the treated thigh as compared with the control thigh was seen 12 weeks after treatment. Investigator improvement scores and subject satisfaction scores indicated that the HIFU treatment resulted in noticeable improvement in the majority of subjects. This is the first description for the use of the HIFU technique to produce a significant circumferential reduction of the thighs.

**LONG-TERM SWEAT REDUCTION WITH NON-INVASIVE SHORT WAVE RADIOFREQUENCY DEVICE IN PATIENTS WITH PRIMARY AXILLARY HYPERHIDROSIS: A PRELIMINARY STUDY**

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**Background:** Radiofrequency (RF) energy is a common modality in non-invasive aesthetic procedures. Short wave spectrum (10–100 MHz) RF waves induce rotational oscillation in water molecules, thus heating tissue structures having high water content, such as hyperactive eccrine and apocrine sweat glands. At these low frequencies, the heating can be applied over an extended period, which may disrupt the gland function and subsequently reduce sweating in primary axillary hyperhidrosis.

**Study:** Twenty patients (17 women, 3 men) assessed by hyperhidrosis disease severity scale (HDSS) [8 patients (40%) HDSS = 4; 12 patients (60%) HDSS = 3] and with positive iodine-starch test were enrolled to the study after being diagnosed with primary axillary hyperhidrosis. Patients underwent 4 axillary (bilaterial) treatments by short-wave (40.68 MHz) radiofrequency device (SweatXTM, Alma Lasers Ltd, Caesarea, Israel) at weekly intervals. Dosimetry on each axilla was 35 kJ and deposited at therapeutic skin temperature between 42 and 44°C. Photography, HDSS and iodine-starch test were recorded 1, 3 & 6 months after final treatment as indicated by iodine-starch test were enrolled to the study after being diagnosed with primary axillary hyperhidrosis. Patients underwent 4 axillary steam treatments using the superpass technique, followed by up to 5 vector passes using the superpass technique, followed by up to 5 vector passes using the superpass technique.

**Results:** Patients demonstrated significant sweat reduction at 1, 3 and 6 months after final treatment as indicated by iodine-starch test and HDSS questionnaire. No treatment-related adverse side effects were recorded during the course of the study. One month after the last treatment all patients shifted from HDSS 3 or 4 to HDSS 1 or 2 as follows: HDSS 4 group (n = 8): 5 patients (63%) converted to HDSS 2 and 3 patients (37%) to HDSS 1; HDSS 3 group (n = 12): 9 patients (75%) converted to HDSS 2 and 3 patients (25%) to HDSS 1. At 6-month follow-up, 11 patients (55%) reported HDSS = 2 and 9 patients (45%) reported HDSS = 1.

**Conclusion:** The use of non-invasive short-wave RF technology is safe and effective for long-term sweat reduction in patients with primary axillary hyperhidrosis.

**EFFICACY OF A NEW TREATMENT TIP FOR THE TREATMENT OF SKIN LAXITY IN THE FACE**

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**Background:** Monopolar radiofrequency (RF) has been proven in several studies to be effective for the treatment of skin laxity by heating collagen fibers to stimulate neocollagenesis. The aim of this study was to evaluate a new treatment tip that delivers a high level of uniform, volumetric bulk heating at the maximum peak temperature for a faster and more comfortable procedure.

**Study:** 15 females with mild to moderate skin laxity at the mid-face, lower face and upper neck were enrolled and treated in this study. The treatment consisted of one treatment session with a monopolar RF device (Thermage® CPT System with Total Tip 3.0, Solta Medical, CA). The treatment regimen consisted of two base passes using the superpass technique, followed by up to 5 vector passes using the superpass technique.
passes with a total of 900 pulses per subject. A digital infrared thermometer was used to ensure a superficial skin temperature of 37–41°C. The efficacy was assessed live and by a blinded rater using 3D pictures taken with an array of stereoscopic cameras (Vectra 3D, Canfield Inc., Fairfield, NJ) at follow-up visits 4, 12 and 24 weeks after baseline.

**Results:** Significant improvement of skin laxity in the mid-face, lower face and upper neck was observed in the majority of patients after 4 weeks and maintained at week 12 and 24. Patient satisfaction scores paralleled the clinical improvements observed. Side effects were mild and limited to transient erythema and edema that diminished within 7 days without additional treatment.

**Conclusion:** The high level of uniform, volumetric bulk heating achieved with the evaluated treatment tip resulted in safe and effective tissue tightening of the cheeks and neck. Although tightening continued to be evident 6 months after a single treatment.

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**#100**

**TREATMENT OF LOCALIZED FAT DEPOSITS AT THE POSTEROLATERAL THIGHS WITH ACOUSTIC WAVE THERAPY – A PARALLEL-SIDE CONTROLLED, RANDOMIZED CLINICAL TRIAL ON 15 FEMALE SUBJECTS**

**Neil Sadick, Andrew Dorizas, Nils Krueger**

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**Background:** Localized fat deposits at the posterolateral thighs are a frequent topographic alteration of the body contour in females. These so-called “saddle bags”, caused by structural characteristics of the subdermal fat and septal bands, are a common cause of embarrassment to many women. The aim of this study was therefore to assess the efficacy and safety of Acoustic Wave Therapy (AWT) for the treatment of saddle bags.

**Study:** 15 patients with localized fat deposits at the posterolateral thighs were treated with Acoustic Wave Therapy in this parallel-side controlled, randomized clinical trial for volume reduction of saddle bags. The patients were treated twice a week for 4 weeks, a total of 8 treatments with two different forms of mechanical waves, planar AWT and radial AWT, during the same session. Data were collected at baseline, immediately after the 8th treatment, at 1 month and at 3 months after the last treatment with a patients' questionnaire, weight control, measurement of circumference, ultrasound of the adipose layer of the treatment area.

**Results:** Measurements with the ultrasound system demonstrate a significant diminution in the subcutaneous fat layer thickness and a reduction of the averaged circumference of thighs. The results of the measurements are in conformity with the clinical improvements and the high satisfaction rate of the patients. Patients reported an improvement in skin topography and firmness as well as a reduction of circumference. No side effects were seen.

**Conclusion:** Acoustic waves have been shown in previous studies to stimulate the regeneration of connective tissue and to increase the cell wall permeability of adipocytes resulting in an increased release of fat, or triglycerides respectively. The results of this study show that AWT is a safe and effective treatment to reduce the volume of localized fat deposits at the posterolateral thighs. Further clinical studies should include histological assessments of the treated area for a better understanding of the mechanism of action.

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**#101**

**COMPUTATIONAL STUDY OF RADIOFREQUENCY-INDUCED THERMAL DAMAGE OF SUBCUTANEOUS ADIPOSE TISSUES WITH DIFFERENT FIBROUS SEPTA ARCHITECTURES**

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**Background:** Radiofrequency (RF) sources are widely used for targeting adipocyte cells. The subcutaneous adipose tissue structure is composed of a fine, collagenous and fibrous septa network enveloping adipocyte cells; however, it is commonly considered as a homogeneous fat layer. Our goal is to assess, quantify and compare the extent of RF-induced thermal damage in subcutaneous adipose tissues with different fibrous septa architectures.

**Study:** We modeled the electric, thermal and damage response of skin, adipose and muscle tissues to 1 MHz RF currents. The RF applicator model corresponds to a non-invasive, monopolar electrode operating at 30 V during 20 minutes. We studied three different architectures of adipose tissue: one constituted homogeneously by fat only, and two constituted by fat and fibrous septa at low and high spatial density distributions.

**Results:** The fibrous septa increase the intensity of the electric field within the adipose tissue. Neglecting the fibrous septa structure, the highest temperature within the homogeneous fat layer is underestimated by 4 (low density) to 6°C (high density). Most important, damage profiles are significantly different: for the homogeneous case, the lesion is symmetrical with ellipsoidal shape and does not exceed the applicator boundaries; for the other architectures, the lesion is asymmetrical and extends laterally beyond the applicator. The lesion volume of tissue with fibrous septa is approximately 7.5 (high density) and 5.5 (low density) times larger than with fat only. Lesion volumes correspond to 63% of loss in viability.

**Conclusion:** Our study demonstrates the significance of the fibrous septa architecture of the subcutaneous adipose tissue for RF heating. For the same RF treatment parameters, the clinical efficacy and safety may vary from patient to patient as a function of the structural configuration and spatial density of the fibrous septa. Preliminary imaging of subcutaneous adipose tissue may allow compensating for structural differences and selecting the appropriate dosage.

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**#102**

**APPLICATION OF PLATELET RICH PLASMA THERAPY COMBINED WITH THE FACELIFT AND LASER**

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**Background:** This study explores the outcomes of using platelet rich plasma as a method to increase collagen production and healing after a facelift and/or a laser treatment.
Study: Fifteen consecutive patients undergoing a procedural rhytidectomy with a combination of radiofrequency were reviewed after receiving post-operative platelet rich plasma therapy. The patient’s baseline photos were taken prior to each procedure. After each facelift, patients receive a laser treatment along with injections of centrifuged plasma into the desired areas. Post-operative photos were taken at 24, 48 hours, and 1 week for reviewing. The photographic review was performed by an independent board of physicians on the Wrinkle Severity Rating Scale and a bruising scale, and scored accordingly.

Results: Fifteen patients, with an average age of 65.2 (±7.3) with a mean BMI of 24.5 (±2.9) received platelet rich plasma therapy. Eight patients received simultaneous face-lifting, laser, and platelet rich plasma therapy while 7 patients received laser and platelet rich plasma therapy only. According to a bruising scale healing took place within 3–4 days for patients who received a face-lift, laser, and platelet rich plasma therapy. For the remaining seven patients receiving a laser treatment and platelet rich plasma therapy, healing took place within 2–3 days. There were no complications after or during each injection of the platelets.

Conclusion: It is demonstrated through the analysis of each post-operative photo at 6 weeks and 6 months, that injection of platelet rich plasma is safe and effective at providing increased collagen production and healing.

#104
GOLD NANOPARTICLE PENETRATION AND PHOTOTHERMAL THERAPY OF MULTICELLULAR TUMOR SPHEROIDS
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Background: Multicellular tumor spheroids (MTS) are in vitro 3D tumor models, which effectively mimic in vivo tumors. MTS have been used for testing drug diffusion extensively, however, only recently have been explored for nanoparticle delivery and therapeutics. Gold nanorods (GNRs) are a class of plasmonic nanoparticles whose optical properties allow for 3D imaging with two-photon microscopy ( TPM) and efficient photothermal therapy. In this work, we explored the penetration characteristics of gold nanorods in MTS and analyzed the damage threshold and cell death pathways during photothermal therapy.

Study: We grow MTS in agarose-coated 96 well plates, forcing the human colorectal tumor cells to adhere to themselves. GNRs were incubated with the MTS for 24 hours before imaging or therapy. For TPM, we stained the MTS with a cellular membrane stain and visualized the GNR penetration into the MTS and internalization into cells. For photothermal therapy, we irradiated the MTS with GNRs with an 808 nm diode laser for 5 minutes at several fluence rates. Then we stained the sample for apoptosis and necrosis and performed flow cytometry to obtain quantitative values.

Results: The GNR delivery into the MTS is shown to be limited to the outer 20% of the MTS radius after 24 hour incubation, which is primarily in the MTS proliferative region. However, we were able to induce significant photothermal damage to the MTS with 30 W/cm² fluence rate. Furthermore, we determined that apoptosis was enhanced at lower fluence rates and necrosis became the dominant cell death pathway at higher fluence rates.

Conclusion: We were able to successfully utilize MTS as an in vitro tumor model to investigate the GNR penetration and induce photothermal damage. Additionally, we measured the cell death pathways initiated during photothermal therapy in a 3D structure. We believe understanding GNR localization and the cell death pathways during photothermal therapy will allow us to optimize the photothermal therapy procedure.

#105
SELECTIVE PHOTOTHERMOLYSIS OF SEBACEOUS GLANDS VIA EFFICIENT DELIVERY OF GOLD COATED MICROPARTICLES INTO THE GLANDS WITH ULTRASOUND, AN EX VIVO OPTIMIZATION STUDY
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Nanoscale photosensitizer clearly inhibited hepatoma cells both in vivo and in vitro. These inhibitory effects may result from the induction of high levels of apoptosis-related protein expression, which trigger the activation of apoptotic pathways that cause the programmed death of cancer cells.
Background: Gold coated microparticles designed for near-IR absorption can be used in selective photothermolysis of skin appendages such as sebaceous glands by combination of delivery into the glands and pulsed laser irradiation. Highly selective targeting of these structures has long been a goal of researchers in this area. Ultrasound assisted delivery of small molecules into skin through the stratum corneum was developed more than a decade ago. In this work, the use of ultrasound is extended to achieve delivery of sub-micron sized particles selectively into the sebaceous glands through the follicular infundibulum.

Study: Ex vivo pig ear with waxed or tweezed hair was used as a model. A cup filled with suspension of the particles was placed on top of skin and an ultrasound horn was immersed in it. Ultrasound energy was imparted to the suspension via the horn. Various parameters such as vibration frequency, horn-skin distance, horn diameter, amplitude of vibration, and application time were examined. After wiping the skin, laser irradiation at 800 nm wavelength was performed. Rates of infundibular damage, gland damage, and deep-gland damage were assessed by examining serial sections under a dissecting microscope. Samples were processed histologically with H&E staining. The stained sections were also analyzed using a two-photon induced photoluminescence (TPIP) imaging to assess presence of the particles.

Results: The delivery of the particles and thermal damage was localized to the follicle entry point, follicle and gland. High rates of infundibular, gland, and deep-gland thermal damage were noted (e.g., 96%, 62%, and 42%, respectively). Histological observations showed significant destruction of the infundibulosebaceous units including the sebaceous glands. TPIP imaging showed presence of the particles deep in the infundibulum, in the ducts and periphery of the glands and generally localized to areas of thermal injury.

Conclusion: Ultrasound assisted transfollicular delivery of nanoparticles into the sebaceous gland has been successfully demonstrated and parameters have been optimized. High rates of follicular thermal alteration, accompanied by significant destruction of the sebaceous glands are observed. This method can be used to treat follicular disorders such as acne by selective delivery of materials into the follicular structures.

#106

BIOCOMPATIBILITY AND THERMAL PROFILE OF TRANSPARENT NANOCRYSTALLINE YTTRIA-STABILIZED-ZIRCONIA CALVARIUM PROSTHESIS

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Background: The long-range goal of the Windows to the Brain (WttB) is to improve patient care by providing a technique for delivering and/or collecting light into/from the brain, on demand, that routine optical imaging and therapy procedures can be performed without inducing thermal damage to the brain covered with YSZ.

Conclusion: The results of these studies suggest that given the biocompatibility and tissue thermal response, YSZ implants can potentially allow for safe and feasible chronic non-invasive optical imaging and therapy of brain.

#107

DYNAMIC CHARACTERIZATION OF IN VITRO BREAST CANCER TUMOR MODELS USING MECHANICAL INDENTATION AND DIFFUSE REFLECTANCE SPECTROSCOPY

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Background: Progression of neoplastic tumor tissue has been associated with morphological remodeling responsible for varying biomechanical and optical properties. In vitro tumor engineered models made from collagen gels have been used to study cancer, but characterization of these constructs is typically destructive in nature. It is hypothesized that integration of nondestructive mechanical testing and diffuse reflectance spectroscopy (DRS) can be used to dynamically and comprehensively monitor progression of in vitro tumor models.

Study: Tumor constructs were prepared using MDA-MB-231 breast cancer cells embedded at a 1.0 × 106 cells/ml seeding density in a 8 mg/ml collagen hydrogel matrix. Constructs were incubated (37°C) and allowed to polymerize. DRS/mechanical indentation experiments were performed at 0, 24, 48 and 96 hrs. of incubation. Acellular collagen gels served as controls. Ramp-and-hold indentation experiments were performed on a material testing frame (Bose Electroforce, Eden Prairie, MN). Load was applied by linearly ramped displacement of a 1.3 mm diameter indenter at 10% strain rate to a final 50% strain for each gel. The final displacement was held constant for 120 seconds and the gels were allowed to relax. Reflectance spectra were recorded throughout the mechanical test.

Results: Mechanical properties did not change overtime for the acellular gels due to incubation, but a decrease in maximum compressive stress was detected in cellularized gels after 48 hrs. of incubation. Percent reflectance measured at peak load tended to be higher for cellularized gels than for acellular gels in the visible spectra. Percent reflectance spectra measured at peak load varied over time for the cellularized gels.

Conclusion: Non-destructive mechanical indentation and DRS combination tests may be used for dynamic in vitro tumor model...
characterization. In future work, fibroblasts will be included in the tumor model and matrix remodeling will be dynamically monitored using these techniques.

#108

EFFECT OF MECHANICAL OPTICAL CLEARING ON NEAR-INFRARED SPECTROSCOPY SIGNAL

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Background: Near-infrared Spectroscopy (NIRS) encompasses broad clinical and research applications. This study focuses on use of NIRS for functional brain imaging. NIRS is limited by its spatial resolution and shallow penetration depth. Additionally, light must first pass through the scalp, where blood perfusion causes significant interference. Responding to these issues, we have implemented mechanical tissue optical clearing (MOC) to improve NIRS technology. MOC utilizes compressive forces to laterally displace blood and water and thin scalp tissue.

Study: A 16-channel NIRS device was used for two procedures. Subjects were tested with both MOC-NIRS and standard NIRS (control). Method 1: Breath-hold exercise. This generates a hemodynamic response in gray matter uniformly throughout the brain. Method 2: Skin “Pinch” test. A NIRS emitter-sensor pair was folded around two dermal locations. The orientation of emitter-detector pairs in this configuration required implementation of neutral density filters to attenuate the signal to avoid saturation.

Results: For the breath hold experiment, we time-averaged standard deviation (STD) values across all 16 channels. MOC-NIRS STD values were .38 (HbO2) and .44 (HHb) while standard NIRS STD values were 1.32 (HbO2) and 1.46 (HHb); a 300%+ increase. The pinch test shows a ~2.5 fold increase in signal amplitude with MOC-NIRS over standard NIRS. No muscle or brain activation was measured, negating its potential attribution to signal modification.

Conclusion: The studies demonstrated MOC improvement on NIRS, including more consistency between channels (lower STD) and increased signal strength through dermis. This process allows for improved light delivery and interrogation of brain hemodynamic signal strength.

#109

INTERSTITIAL RECOVERY OF INTRINSIC FLUORESCENCE FROM SINGLE-POINT MEASUREMENTS IN HIGHLY ABSORBING AND SCATTERING MEDIA

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Background: We have developed a method for the recovery of intrinsic fluorescence from single-point measurements in scattering and absorbing media without prior knowledge of the sample optical properties. This recovery of intrinsic fluorescence has only been demonstrated previously in cases where the optical properties are known a priori or the source and detector are spatially separated. The objective of the study was to demonstrate accurate recovery of fluorophore concentration in samples with varying optical properties.

Study: Phantoms consisting of varying concentrations of doxorubicin as fluorophore, MnTPPS as absorber, and Intralipid-20% as scatterer were created. Fluorescence measurements were made using a single isotropic probe as the excitation source and detection fiber. Detected fluorescence spectra were analyzed using a forward-adjoint fluorescence model in order to recover doxorubicin concentration and the background optical properties.

Results: Recovery of doxorubicin concentration was demonstrated with a mean error of 11.8% over 25 samples. The concentration of MnTPPS was recovered with a mean error of 23.2% and the scattering spectrum was recovered with a mean error of 19.8%.

Conclusion: The method described here will allow for the determination of localized concentrations of fluorescent drugs, such as doxorubicin, from single-point fluorescence measurements. This could prove useful in the context of treatments such as transarterial chemoembolization (TACE), where drug uptake and concentration can vary between patients.

#111

QUANTITATIVE ASSESSMENT OF HAIR COUNTS, THICKNESS AND COLOR DURING AND AFTER LOW-FLUENCE LASER TREATMENTS: A RANDOMIZED CONTROLLED TRIAL

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Background: At-home laser and intense pulsed light hair removal continues to grow in popularity and availability. A relatively limited body of evidence is available on the course of hair growth during and after low-fluence laser hair removal. Therefore, we wanted to assess hair counts, thickness and color during usage and after cessation of low-fluence laser hair removal.

Study: Thirty-six females with Fitzpatrick skin types I-IV and light brown to dark brown axillary hairs were included. Entire axillary regions were randomized to 0 (control) or 8 self-administered weekly treatments with an 810 nm home-use laser at 5.0–6.4 J/cm². Standardized clinical photos were taken before each treatment and up to 3 months after the final treatment for computer-aided quantification of hair count, hair thickness and hair color. Side effects were evaluated at each visit.

Results: Thirty-two females completed the protocol. During sustained usage, hair growth reduction reached a plateau of up to 59% while remaining hairs became up to 34% thinner and 5% lighter ($P < 0.0001$). In accordance with the objective findings, the majority of subjects (77%) reported moderately to much less hairs in treated than untreated axilla and assessed remaining hairs as thinner and lighter (~60%). Subjects reported mild transient erythema, discomfort and burning sensation during laser treatments. After treatment cessation, growth of hairs gradually returned to baseline levels and at 3 months after the final treatment, the amount of growing hairs and hair thickness exceeded pretreatment values by 29% and 7%, respectively ($P = 0.012$). This is most probably explained by synchronization of hair growth and thus, an increased number of anagen hairs.

Conclusion: Sustained usage of low-fluence laser induced a stable reduction of hair counts, thickness and color. Reduction of efficacy measures was reversible and hairs regrew after cessation.
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#112

MOLECULAR EXPRESSION OF S100A6 GENE IN ADULT OSTEOBLAST CULTURES AFTER LOW-LEVEL LASER IRRADIATION

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**Background:** S100A6 (calcium binding protein A6) gene is involved in osteogenesis and codifies a protein of the S100 family which contains a calcium linked domain of cells involved in the regulation of cellular cycle progression, differentiation, intracellular homeostasis, calcium signaling and an ion transport.

**Objectives:** To evaluate the expression of the S100A6 gene in adult osteoblast cultures after low level laser irradiation (LLLI).

**Study:** Twenty-four adult, Wistar rats were assigned into 2 groups A (n = 12, laser) and B (n = 12, without laser) and underwent a surgical procedure to remove a 5 mm fragment of the femur shaft which were submitted to a mechanical and enzymatic digestion process by collagenase type II (2 mg/mL) in order to obtain adult osteoblasts. Cells were cultivated for 15 days at 37°C in a 5% of CO₂ environment. Laser was applied between the eighth and thirteenth day of culture, daily, at one point with 808 nm, power density of 200 mW/cm², nominal dose of 2 J/cm², spot diameter of 0.02 mm for 5 s. After the thirteenth day an RNA extraction and cDNA syntheses were performed with Superscript III® for RNA totals equal to or above 10 μg. The genetic expression was evaluated using Real Time Polymerase Chain Reaction technique (qRT-PCR) with 2 μl of cDNA and 8 μl of PCR master mix SYBR® Green using the β-actin (primer control) and S100A6.

**Results:** The cycle threshold values (Ct) underwent statistical analysis using the Anova Tukey post-test (P < 0.05). Regarding gene S100A6, groups A (0.91366) and B (0.89003), showed no differences (P = 0.38017). However the group A expressed S100A6 gene earlier than group B. Furthermore, this expression was more specific than in group B.

**Conclusion:** LLLI most likely increased the mitotic process and the replacement of cell DNA. Further studies are necessary to better understand the cell mechanisms involved in osteogenesis, calcium liberation and membrane transport.

#114

LIGHT THERAPY ELICITS A DOSE-DEPENDENT ANTI-INFLAMMATORY RESPONSE IN A HUMAN FULL-THICKNESS SKIN ANALOG

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**Background:** Wound healing is a complex process involving many factors and cell types. The beneficial results reported for light therapy in vitro are only ameliorated by their lack of correlation in vivo. The benefit of studying these effects on a differentiated keratinocyte and fibroblast co-culture is the opportunity to examine in vitro intercellular effects in a controlled environment while preserving many of these complex relationships. The aim of this study was to examine and quantify these effects at several common wavelengths and energy densities on full-thickness dermal analogs.

**Study:** In this study 24 full-thickness human skin analogs in culture were broken into six groups and treated with light at 630, 660 or 810 nm, at an energy density of 1.5 or 3 mJ/cm². Six tissues received no treatment and served as controls. The total energy applied to all tissues was 4 J/day with treatments on day 1 and 2. Supernatant samples were collected pre-irradiation on day 1 and again on day 3 at the completion of the 48 hour time course. Tissue biopsies were collected day 2 before the second treatment and day 3. Real time RT-PCR and ELISA were used to quantify mRNA cytokine transcripts and protein products respectively.

**Results:** All treatment groups showed a lower level of inflammatory cytokite production than control. The 630 nm treatment (specifically), resulted in a 1-3 fold reduction in IL-1β, IL-6 and TNF-a mRNA from day 2 to day 3. Supernatant levels of IL-6 were significantly lower in the 630 and 810 nm treatment groups (P < 0.05), while the 630 and 810 nm treatment groups also exhibited a fluency-dependent lower inflammatory cytokite production at 1.5 mW than 3 mW.

**Conclusion:** These experiments effectively demonstrate in vitro similar anti-inflammatory processes as reported in vivo. The further marriage of light therapy and full-thickness dermal analogs may allow for a better understanding of the complicated wound healing pathways light therapy affects. Furthermore it was demonstrated that the rate of delivery of light treatment directly impacts its effectiveness.

#115

THE COMBINED BACTERICIDAL EFFECT OF 470 nm LIGHT AND HYPERBARIC OXYGEN ON METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS

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**Background:** It is known that certain wavelengths of blue light kill MRSA, and that hyperbaric oxygen (HBO) suppresses the growth of the bacteria. HBO alone has been shown to clear as much as 28% of 240 ± 24 colony forming units (CFU) of the bacteria while 470 nm light clears 92% of a standard culture of MRSA in one shot. We studied the effects of 470 nm light and HBO to determine if this combination can yield optimal bacterial clearance in in vitro simulation of mild, moderate or heavy MRSA infections.

**Study:** Different culture densities (3 × 10⁶, 5 × 10⁶ and 7 × 10⁶ CFU/mL) of MRSA were treated with HBO (hyperbaric hyperoxia, 2.0 atmospheres, 100% oxygen) and/or 55 J/cm² of 470 nm blue light. Irradiation protocol for all densities involved the application of blue light and/or exposure to HBO as follows: (1) Control (no irradiation, no HBO), (2) HBO only, and (3) exposed to HBO (55 J/cm² + HBO), (4) HBO only, and (5) HBO exposure and then 55 J/cm² (HBO + 55 J/cm²).

**Results:** The bactericidal effect of combined blue light and HBO on MRSA clearance was commensurate with the results for blue light treatment alone, with blue light producing as high as 97.3 ± 0.2% clearance in the mild infection model (3 × 10⁶ CFU/mL) and the combination approximately 94.7 ± 4%
for (55 J/cm² + HBO) and 97.5 ± 2.5% for (HBO + 55 J/cm²). Notably, HBO treatment at this density produced significantly (P < 0.0001) less bacterial clearance (43.3 ± 0.81%) when compared to either blue light or a combination of blue light and HBO. Increasing bacteria density to moderate (5 x 10⁶ CFU/mL) and heavy (≈7 x 10⁶ CFU/mL), highlighted the superiority of blue light or combined therapy over HBO.

Conclusion: The combined bactericidal effect of blue light and HBO on MRSA clearance was profound and similar to that observed when blue light alone was utilized.

#116

FEASIBILITY STUDY OF IMAGING THE ENDOGENOUS UV FLUORESCENCE OF CELLS TO EVALUATE EPITHELIALIZATION

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Background: A fundamental characteristic of tissue engineered skin substitutes is the ability to permit the establishment of a surface barrier; that is, the proliferation and differentiation of keratinocyte cells on decellularized tissue scaffolds. Our practical goal is to evaluate the feasibility of using the endogenous ultraviolet (UV) fluorescence of cells to image and evaluate epithelialization of tissue scaffolds.

Study: Live human skin biopsies were implanted on acellular porcine dermal scaffolds and cultured in vitro for weeks. Porcine scaffolds were prepared using freeze/thaw thermal cycles and thorough PBS washing. Three human skin biopsies apart were implanted in each scaffold forming a line. An imaging system that illuminates at 300 nm and collects light at 340 nm was used to image cellular proliferation every two days for weeks. We also implanted these constructs into full-thickness wounds in BALB/c nude mice. Histology (H&E staining) was used to correlate images and epithelialization in both experiments.

Results: In vitro, keratinocytes from the skin biopsies were able to proliferate and differentiate creating a new epithelium that covered almost the entire surface of the scaffold. UV images show high intensity fluorescence where the new epithelium was forming and low intensity fluorescence where the skin biopsies were located. The growth of the epithelium was not symmetric and did not show any preferential direction. Histology shows new epithelium where the fluorescence intensity is high and a scaffold devoid of cells beneath the new epithelium. In vivo, a similar epithelialization process was initially observed but then desiccation occurred.

Conclusion: Our preliminary studies show that the UV endogenous fluorescence of cells to image epithelialization of tissue scaffolds. Currently, our system is able to provide spatial information that could be used to study and develop skin substitutes in non-invasive, non-destructive ways.

#117

STUDY OF ENDOGENOUS SKIN UV-FLUORESCENCE EMISSION IN WOUND HEALING

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Background: Preliminary studies suggest that the endogenous fluorescence emission of skin on the ultraviolet (UV) regime can provide functional information of skin biology, such as cellular proliferation and variations in collagen and elastin crosslinks. In this study, we aim to explore the feasibility of using the skin UV endogenous fluorescence to monitor and evaluate wound healing processes in particular, closure and remodeling.

Study: Excitation-emission matrices were collected at different times during the healing processes of full-thickness biopsy wounds in mice and cutaneous wounds in human subjects. The emission and excitation spectral wavelengths were 290–520 and 240–520 nm, respectively. The mice were BALB/c nude type. Biopsy wounds were monitored daily during 8 days. The cutaneous wound was monitored in intervals during two weeks. Excitation-emission matrices from normal skin were used as controls.

Results: Relative to controls, the fluorescence intensity of the excitation-emission wavelength pair (300/340 nm) attributed to tryptophan fluorescence in cellular proliferation increased, peaked and then decreased as the wound was closing. This was observed in mice and human. The fluorescence intensity of the excitation-emission pair (340/390 nm) attributed to pepsin digested collagen-crosslinks remained flat during the first 5 days and then increased. This was only observed in human. Comparisons of excitation-emission matrices of normal skin show that the mice and human skin differ in the 320–520 nm and 420–520 nm range. In this spectral range there is no fluorescence in mice.

Conclusion: Our preliminary studies show that the 300/340 nm excitation-emission UV fluorescence pair may be used to monitor and evaluate wound closure by following cellular proliferation, and the 340/390 nm pair may be used for wound dermal remodeling by following changes in collagen-crosslinks. Our results also suggest that the BALB/c nude mice may be a good model for studying cellular proliferation but not for dermal remodeling. Further studies are warranted.

#119

WAVELENGTH-DEPENDENCE OF FRACTIONAL ABLATIONS IN BIOLOGICAL MATERIALS USING A TUNABLE CR2+:ZNSE/S INFRARED LASER

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Background: Traditionally, fractional laser treatments are investigated. Studies of excitation-emission matrices from normal skin show that the mice and human skin differ in the 320–520 nm and 420–520 nm range. In this spectral range there is no fluorescence in mice.

Conclusion: Our preliminary studies show that the 300/340 nm excitation-emission UV fluorescence pair may be used to monitor and evaluate wound closure by following cellular proliferation, and the 340/390 nm pair may be used for wound dermal remodeling by following changes in collagen-crosslinks. Our results also suggest that the BALB/c nude mice may be a good model for studying cellular proliferation but not for dermal remodeling. Further studies are warranted.
#120

NOVEL FACTORS THAT AFFECT TOPICAL UPTAKE ENHANCEMENT FOLLOWING NON-ABLATIVE FRACTIONAL LASER TREATMENT

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**Background:** The stratum corneum is the chief barrier to prevent the entrance of exogenous substances into the skin. Invasive techniques such as microdermabrasion, injectables, and ablative lasers have been previously employed to circumvent this barrier. This study aimed to identify factors such as wavelength, molecule size, and formulation which enhanced topical uptake together with non-ablative fractional resurfacing techniques.

**Study:** Freshly excised skin specimens were treated with a non-ablative fractional laser (restore DUAL, Solta Medical Inc.). Topical uptake of various formulations was quantified using Franz Cell permeation systems and time-resolved high-performance liquid chromatography.

**Results:** 1550 nm treatment showed 30.1 ± 9.6 enhancement of a vitamin C formulation, while 1927 nm showed 119.4 ± 0.03 enhancement as compared non-laser treated controls. A non-aqueous minoxidil formulation produced a 4.4 ± 0.3 enhancement when compared with an aqueous formulation. Notably, laser treatment reversed this trend, with the aqueous formulation producing a 1.4 ± 0.2 enhancement. Overall, minoxidil uptake ranged from 1.7 ± 0.2 to 7.5 ± 1.1 enhancement over non-laser treated controls. Various molecular sizes of dextran were tested to understand the size exclusion criterion. Laser treatment enhanced the 3 kDa molecule by a factor 3.1 ± 0.2, with the 10 kDa molecule only penetrating the skin, and the 20 kDa molecule remaining undetected. The non-laser treated controls prohibited penetration throughout the 24 hour test duration.

**Conclusion:** Fractional laser treatment in conjunction with the appropriate formulation offers an innovative tool for overcoming common drug delivery hurdles. Prior work by our group has shown safe and effective topical uptake enhancement using non-ablative fractional resurfacing techniques. This study showed that thermal lesion characteristics based upon absorption coefficients via wavelength selection allow for selective titration of topical uptake. This is the first demonstration of aqueous formulations effectively penetrating the stratum corneum with greater efficacy than non-aqueous formulations, and the uptake enhancement of large molecules the size of small proteins and growth factors, while retaining the barrier function of the stratum corneum.

#121

MOLECULAR MECHANISM FOR ONGOING DERMAL REMODELING FOLLOWING FRACTIONAL 1927 nm LASER TREATMENT

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**Background:** Fractional laser treatment remains the gold standard for skin resurfacing and rejuvenation. This study aimed to characterize the changes in the skin at the molecular level following fractional laser treatment.

**Study:** Forearms of five subjects were treated using a 1927 nm laser (Clear + Brilliant™ Perméa, Solta Medical, Inc.) in an IRB approved study. In vivo responses at one and fourteen days post-treatment were quantified via gene expression analysis.

**Results:** At one day post-treatment there was a statistically significant upregulation of MMP3 (matrix metalloproteinaes 3), and a trend of TGFβ1 (transforming growth factor beta 1) and SERPINH1 (heat shock protein 47) upregulation as compared to untreated control. Also seen at day one was a statistically significant downregulation of COL1A1 (collagen type I) and COL3A1 (collagen type III). At fourteen days post-treatment there was a trend of upregulation of TGFβ1, COL1A1, and COL3A1 expression, while SERPINH1 and MMP3 returned to normal baseline levels.

**Conclusion:** Non-ablative fractional 1927 nm laser treatment initiated the upregulation of multiple mediators of the dermal remodeling response. TGFβ1, a potent stimulator matrix proteins synthesis, showed early increased expression. Treatment induced a transient upregulation of MMP3 and SERPINH1. MMP3 is involved in the breakdown of extracellular matrix during tissue remodeling, while SERPINH1 is associated with the wound healing response, and is essential for the synthesis and assembly of collagen. TGFβ1, COL1A1, and COL3A1 showed increased expression at fourteen days-post-treatment demonstrating a sustained response. COL1A1 is the predominant protein in the skin, provides tensile strength, and its content and organization is required for the maintenance of healthy skin. Newly synthesized COL3A1 during would healing initiates the dermal remodeling cascade. Together the increased expression of key components of the dermal remodeling response provide a mechanistic explanation for the clinical results of skin rejuvenation following non-ablative fractional 1927 nm laser treatment.

#122

HISTOLOGICAL EPIDERMAL AND DERMAL CHANGES OF FRACTIONAL 1064 nm Q-SWITCHED LASER PULSES

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**Background:** The concept of fractional laser and its spatio-temporal sequence of wound healing has been widely investigated. Recently fractionated Q-switched 1064 nm laser were developed and a significant remodeling of the skin in response to its application were published. However less is known to its corresponding histology.

**Study:** Human skin explants were used to investigate the effects of a fractionated 1064 nm q-switched laser at the epidermis and dermis using 600 and 1200 mJ/P @ 5–10 passes. Histology was performed according SOP using H&E as well as elastic stains.
Changes at the skin were evaluated using a calibrated microscope (Olympus, BX41) equipped with a cooled digital camera (Olympus, DP70). Images were analyzed by the help of software CellF (Olympus, Germany).

Results: 12 Skin explants were used to apply fractional 1064 nm Q-switched laser beams (600 and 1200 mJ/P @ 5–10 passes). In general there were no significant changes visible at the epidermal compartment while within the actinically damaged part of the dermis in typical fractional disruption pattern at sizes up to app. 400 × 440 μm disruptions of the fibers were visible.

Conclusion: On a histological level here were confirm for the first time a fractional pattern of disruption of predominantly sun damaged dermal tissue while the epidermal compartment remained unchanged. As compared to other fractional lasers this might stimuli a dermal remodeling which explains the already known clinical results.

#123

WOUND HEALING OF MICE LIVER TISSUE AFTER ABLATIVE FRACTIONAL CO2 LASER EXPOSURE
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Background: Fractional CO2 laser has become a popular treatment modality to improve fibrosis and scarring of skin. In spite of its great success in dermatological tissues, there is virtually no data available on the wound healing of laser-induced small spot lesions in non-dermatological tissues. As also other organs suffer from the sequela of fibrosis, we investigated the effects of fractional laser exposures on healthy liver tissue.

Study: Six-week-old homozygous BALB/c female mice, 20–23 g were used for this study. After anesthetizing through an intraperitoneal injection of a cocktail containing ketamine (90 mg/kg) and xylazine (9 mg/kg), laparotomy was performed and the liver was exposed to ablative fractional CO2 laser (UltraPulse, Lumenis) with a pulse energy; 50.0 mJ, density; 1%, 5% and 15%, irradiation field 9 × 9 mm. Mice were sacrificed immediately and different time up to one month after a single laser treatment.

Results: In the 1% density group, focal liver damage caused by laser irradiation healed quickly and recovered completely by day 14. However in the 5% and 15% density group, progressive liver damage was frequently observed. For such higher densities the area of necrotic liver injury became quickly confluent and widespread.

Conclusion: We investigated healing process of liver after irradiation of fractional CO2 laser. Liver has a great ability to very quickly regenerate after small spot laser injury. However, when a critical density was reached, organ failure become evident by widespread and confluent necrosis.

#124

DOSE-RESPONSE BEHAVIOR OF HUMAN HAIR FOLLICLES DURING LASER-BASED PHOTOEPILATION
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Background: Balancing efficacy versus safety in photoepilation and identifying treatment parameters for challenging hairs requires understanding of physiological impact on hair follicles induced by different treatment parameters. To achieve this, an ex vivo hair follicle model was developed. The objective of this study was to investigate the anagen-to-catagen (AC) transition of hair follicles subjected to a wide range of fluences.

Study: Human skin samples with living hair follicles obtained few hours post-surgery were treated using a range of fluences (0–28 J/cm²) applied in a single pulse of an 808 nm laser-based system. Both control and treated follicles (minimum n = 50 hairs from 4 donors) were extracted, placed in culture, and used for evaluation of macroscopic damage during 7 days. At day 2, 5–10 follicles were sacrificed for histological cell viability analysis using H&E- and TUNEL methods. An expected impact of the treatment parameters on follicles was estimated using a proprietary opto-thermal model.

Results: At 2-4 J/cm², AC transition due to treatment was observed in 11% of the follicles. This percentage gradually increased at 6 and 8 J/cm² (38% and 61%, respectively). At settings of 16 J/cm² and 28 J/cm², ~90% of the hairs turned into catagen. Based on macroscopic- and histological cell damage analysis five different classes of AC transitions were distinguished and rated on damage severity. The identified macroscopic and histological damage was traced-back using the opto-thermal model and used to estimate the thermal load and damage.

Conclusion: A dose-response curve showing the behavior of hair follicles subjected to a wide range of fluences during laser-based photoepilation was created and directly linked to opto-thermal and cell viability analysis. This dose response curve and the observed AC transitions enable to interpret the efficacy related to different photoepilation settings, facilitating the prediction of required treatment parameters for challenging hairs.
ADJUVANT EFLORNITHINE TO MAINTAIN IPL-INDUCED HAIR REDUCTION IN WOMEN WITH FACIAL HIRSUTISM: A RANDOMIZED CONTROLLED TRIAL
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Background: Previous studies demonstrate reduced hair growth from a combination of topical eflornithine and intense pulsed light (IPL). Yet, the ability of eflornithine to maintain IPL-induced hair reduction is uncertain. The aim of this study was to investigate whether topical eflornithine reduce hair regrowth in women with facial hirsutism after IPL treatments.

Study: This study was a randomized, intra-individual, split-face controlled trial of topical eflornithine versus no treatment. Originally, patients had moderate to severe facial hirsutism, and were treated with a series of 4-6 IPL treatments. Topical eflornithine was initiated two days after final IPL treatment (baseline). In total, 18 of 22 included patients completed the study (median age 37 years). Patients applied topical eflornithine twice a day for six months and were assessed at baseline and at 1, 3 and 6 months of treatment. Primary endpoint was reduction in hair counts based on clinical standardized photographs. Secondary endpoints were: patient-evaluated efficacy (rang scale of 0–3; representing no to significant side difference), patient satisfaction (Visual Analog Scale of 0–10; representing no to maximal satisfaction) and adverse effects.

Results: Topical eflornithine decreased the rate of hair regrowth and sustained reduction in hair counts after six months of treatment. Compared to baseline, mean values of hair counts in treated versus untreated control sites were 48% vs. 66% at 1 month ($P = 0.022$), 90% vs. 100% at 3 months ($P = 0.150$) and 78% vs. 105% at 6 months ($P = 0.025$). At 6 months, patient-evaluated efficacy supported data on hair counts (median 1) and patient satisfaction was overall high (median 6). Topical eflornithine was generally well tolerated. Two patients experienced acne in treated site at final assessment.

Conclusion: Topical eflornithine maintains post IPL-induced hair reduction with additional reduction in hair counts.

#130
MANAGING COMPLEX AND RECALCITRANT WOUNDS WITH LOW-INTENSITY LASER THERAPY
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Background: Complex wounds are one of the most difficult medical conditions to treat despite many advances in conventional wound care. Whether they are aggravated by chronic illnesses or complicated by poor compliance and ineffective wound care practice, many patients are long-suffering due to recalcitrant wounds. Low-Intensity Laser Therapy (LILT) is not only known to provide significant success in decreasing chronic inflammation, but has also been documented to enhance wound healing and tissue repair.

Study: To evaluate and document the progress of LILT treated patients with various intractable wounds previously treated with conventional wound care, including topical ointments, antibiotics and bandages. Measures included wound area, rate of healing and pain score.

Results: Eight patients with intractable wounds including vascular/diabetic ulcers and post-surgical recalcitrant wounds of the lower extremity were evaluated and photographed before, during and after the final course of Laser Therapy treatments. The protocol consisted of the application of a red (660 nm) light-emitting diode (LED) array (750 mW, 10 mW/cm²), infrared (840 nm) LED array (1500 mW, 20 mW/cm²), red laser (660 nm, 75 mW, 750 mW/cm²) and infrared laser (830 nm, 180 mW, 1800 mW/cm²). Wounds that were unresponsive to prolonged periods of conventional wound care demonstrated a significant response to Laser Therapy in terms of neovascularization, collagen formation and re-epithelialization from wound edges. Reduction in pain score and wound area was found to be proportional to frequency of treatments. Compliance with the treatment programme resulted in a rapid reduction in pain and wound dimensions.

Conclusion: LILT is a therapeutic approach that not only expedites the inflammatory process but more importantly enhances tissue healing, even with chronic and intractable wounds.
neurotoxins. Outline a practical algorithm for concomitant treatments. Review proper patient selection and management of patient expectations, including importance of photographic documentation. Outline the typical postoperative timetable, including anticipated side effects and clinical results.

**Conclusion:** The use of combination techniques can be used safely and effectively without additional postoperative risk, thereby resulting in increased patient satisfaction.

### #132

**COMBINATION THERAPY: MECHANICAL RESURFACING WITH ADIPOSE-DERIVED STEM CELL INFUSION**

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**Background:** Mechanical skin resurfacing can produce results for patients with dyschromias, fine rhytides, acne scarring, and oily/sebaceous skin, and can increase overall tone, texture and skin rejuvenation. Adipose-derived stem cell conditioned media, display multi-lineage developmental plasticity and secrete various growth factors that control and manage the damaged neighboring cells. The essential functions of adipose derived stem cells produce and secrete growth factors which in turn have diverse regenerative effects in the skin. Conditioned medium from adipose derived stem cells stimulates both collagen synthesis and migration of dermal fibroblasts, which can improve the wrinkling, accelerate wound healing and improve overall appearance of skin according to Experimental Dermatology May 2011 issue. The overall result is that the skin looks healthy, radiant and exhibits improved aesthetic appearance. Mechanical resurfacing has evolved into a popular non-invasive cosmetic procedure for photo-aging and other common cosmetic concerns and ADSCs are emerging as a leading ingredient in today's skin care products. The objective is to show that optimal results are obtained when combining mechanical resurfacing followed by an ADSC media infusion applied during the same in-office procedure.

**Study:** Mechanical resurfacing (microdermabrasion, mechanical exfoliation or microresurfacing) employs the use of a medium, such as a diamond or bristle tip. The medium is combined with vacuum for exfoliation of the stratum corneum as well as circulation, which supports the inflammatory response in the dermis. An increase in collagen remodeling is shown as well as the stratum corneum normalizing and achieving a healthy ‘basket weave’ appearance. There is also increased hydration by improving the barrier function of the skin. When the stratum corneum is removed from the mechanical resurfacing immediately prior to an adipose derived stem cell media serum or infusion, the ADSC media will have increased penetration into the skin. This will maximize the results of wound healing properties and skin regeneration from the ADSCs.

**Results:** Both mechanical resurfacing and the use of topical ADSCs show an improvement in the skin, but the combination therapy of mechanical resurfacing and using an ADSC media serum or infusion immediately post delivers a synergistic result. Not only are results vastly improved, but any downtime is also decreased with the wound healing benefits of ADSCs.

**Conclusion:** Today, patients desire results with little to no downtime, and the combination therapy of mechanical resurfacing with an ADSC media serum or infusion during a single treatment capitalizes on these demands.

### #133

**CLINICAL PEARLS IN THE LASER PRACTICE**

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**Background:** Due to the myriad of laser technologies available clinical pearls to optimize patient care are presented from the experience of a laser center. Clinical pearls associated with the following lasers will be presented: pulsed dye laser, 755 nm picosecond laser, ablative fractionated laser, non-ablative fractionated laser, and erbium lasers. We encounter many patients with bruising seen after plastic surgery procedures; specifically face lifts, as well as filler and neuromodulator treatments, which can all be easily treated with pulsed dye laser. To prevent hypopigmentation which can be seen after tattoo removal in patients with darker skin types, we decrease the risk using a hydrogel patches. The healing after ablative and non-ablative fractionated lasers can be improved with an oxygen facial infused with vitamins. Lastly, patients with superficial surgical defects, especially on the nose can be treated with erbium laser for improved scar cosmesis. These clinical pearls will be reviewed more extensively.

**Study:** Review of clinical pearls from experience in a comprehensive dermatology practice.

**Results:** In our center, various lasers are utilized for different indications; we present our clinical pearls when using these laser modalities in specific clinical scenarios.

**Conclusion:** Clinical pearls are reviewed to optimize patient outcomes. We review these clinical pearls as well as the measures that need to be taken upon, during and after the procedure for optimal outcomes.

### #134

**UPDATE ON NEW TECHNOLOGIES IN THE CLINICAL LASER PRACTICE**

**Tracy Ovtcharov, Jennifer Crum, Kim Ventura, Danielle Martorano, Hamad Alabdulrazzaq, Jeremy Brauer, Yoon-Soo Cindy Bae-Harboe, Roy Geronemus**  
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**Background:** Laser technology continues to advance and innovative therapies are on the horizon. Although these laser modalities are FDA approved for the treatment of specific indications, we review the application of a variety of lasers for additional clinical diagnoses. The following lasers will be reviewed: 755 nm picosecond laser for acne scars, stretch marks; radiofrequency coupled with pulsed dye laser for persistent port wine stains; 1927 nm non-ablative fractionated laser for melasma and hyperpigmentation; and pulsed dye laser for the treatment of benign familial nevi. A combination approach for the treatment of facial angiofibromas, in addition to treatment of port wine stains in patients of higher Fitzpatrick skin types will be briefly reviewed.

**Study:** A review of new laser technologies and their clinical application are presented.

**Results:** Although laser devices are aimed to treat FDA approved specific indications, we review new clinical applications of established lasers. We also introduce new laser technology on the horizon to further improve patient treatment and outcomes.
Conclusion: Multiple lasers can be used for a variety of clinical indications. We review these new indications, including the measures that need to be taken upon the procedure and post care.

#135

PERIOPERATIVE PROTOCOL FOR LASER THERAPY
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Background: Patient safety and comfort are important factors to consider when utilizing laser therapy. Many potential adverse events can be avoided with proper perioperative planning and post-operative instructions communicated to the patient. Complications after laser surgery include infection, scarring and dyspigmentation. To avoid these outcomes, our office employs a checklist to ensure that all measures are taken to avoid any complications. These methods include perioperative antibiotics, antivirals, pain medication, specific skin care regimens and clear instructions on how to care for the treated sites. Patients are also given a written hand out for further reference. In our center, precautions are taken to ensure optimal outcomes.

Study: A review of perioperative preparation for the following laser treatments are reviewed: ablative fractionated laser treatment, non-ablative fractionated laser treatment, and pulsed dye laser.

Results: Potential complications after laser surgery include infection, scarring, dyspigmentation. We review our perioperative protocol to ensure patient safety and comfort for specific laser modalities.

Conclusion: Careful pre-treatment planning and clear post-operative instructions are important for patients undergoing laser treatment. We will provide an extensive review on our office protocols to ensure optimal patient care.

PHOTODYNAMIC THERAPY (PAPDT)

#136

THE PHOTODYNAMIC THERAPY EXPERIENCE OF A HIGH VOLUME LASER AND DERMATOLOGIC SURGERY CENTER
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Background: Photodynamic therapy (PDT) is FDA approved for the treatment of actinic keratoses. However, the dermatologic literature reports utilization of multiple sensitizing agents and light devices, varying treatment parameters including incubation times, and suggests that PDT is used in the treatment of additional dermatologic conditions.

Study: Retrospective chart review of patients who underwent PDT between January 1, 2007 and December 31, 2011. Demographic as well as initial treatment data of eligible patients were recorded.

Results: One thousand five hundred and sixteen patients were identified and 1,469 patients (96%) found eligible for inclusion with 1,380 (94.5%) patient charts reviewed. Mean age was 59 years, 59.8% were women. 85.7% of patients were skin types I and II, 63.0% had a history of at least one non-melanoma skin cancer, 10.8% had a history of previous malignant melanoma, and 55.2% had previously underwent Mohs micrographic surgery. The most frequent indications for treatment included actinic keratoses (96.0%), non-melanoma skin cancer (2.6%), and acne (1.0%). For those patients receiving treatment for AKs, 87.4% had treatment of the head and neck and 5.5% had treatment of multiple anatomic locations. 98.5% received ALA and 1.5% received MAL. Light delivery included individual or concurrent use of blue light (74.0%), red light (23.0%), and pulsed dye laser (PDL; 6.5%). Intralesional administration of the photosensitizing agent was used in 1.9% of patients. Patients treated for non-melanoma skin cancers were more likely to receive intraleisional administration of photosensitizing agent (73.5%) and PDL (33%).

Conclusion: This retrospective review of patients undergoing PDT in a high volume laser and dermatologic surgery center demonstrated that the most frequent indication was actinic keratoses, followed by non-melanoma skin cancer and acne. Of interest, patients being treated for non-melanoma skin cancer were more likely to receive intraleisional administration of photosensitizing agents.

#137

QUANTITATIVE VOLUMETRIC CHANGES AFTER CONVENTIONAL ALA-PDT COMPARED TO A NEW INHIBITORY PDT METHOD (i-PDT) TO REDUCE INFLAMMATION IN A PRELIMINARY STUDY
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Background: Topical aminolevulinic acid (ALA) is a pre-cursor drug leading to the accumulation of porphyrins. Conventional ALA-PDT with high-fluence red light is an effective treatment for acne. Adverse epidermal damage and side effects, such as intense pain, erythema, and edema often ensue. We investigated exposure to low-level blue light during the ALA metabolism as a way to prevent accumulation of epidermal porphyrins. We coined this phenomenon “photoinhibition” of PDT or “i-PDT”. Following our pilot study, we observed visible inflammatory changes between the conventional ALA-PDT and i-PDT; however, edema was difficult to assess using common digital photos. We thus sought to compare and quantify the volumetric changes between conventional ALA-PDT and i-PDT.

Study: Of 31 subjects enrolled with facial and back moderate-severe acne, 16 had their pictures taken using the Canfield Vectra X3 three-dimensional camera before PDT, immediately after treatment, and in 24-hours. Images were standardized to landmarks for the volumetric measurements. For each area of interest, six measurements were taken to ensure accuracy.

Results: Immediately following PDT treatment, sites treated with ALA-PDT were more edematous than those treated with i-PDT (P < 0.0001). Twenty-four hours after PDT treatment, both
ALA-PDT and i-PDT sites increased in volume, yet the ALA-PDT sites remained statistically more swollen.

**Conclusion:** i-PDT is a new treatment technique that can lessen major side-effects from conventional ALA-PDT, which have been quantitatively measured in 3D photo analysis. i-PDT causes statistically significant less acute and delayed edema than conventional ALA-PDT.

#138

**CLINICAL RESPONSE OF VULVAR LICHEN SCLEROSUS TO PHOTODYNAMIC THERAPY USING METHYLENE BLUE AND RL50® LIGHT SOURCE**

Renata Belotto, João Paulo Tardivo, Mauricio Baptista, Roberto Santos, Rosangela Itri

**Background:** Vulvar lichen sclerosus is an lymphocyte mediated inflammatory dermatosis that have important clinical implications like introit stenosis, vulvar atrophy, labia minora fusion, intense itch results in excoriations, dyspareunia and painful defecate. One of the treatment modalities is photodynamic therapy (PDT). The aim was to investigate the efficacy of PDT in women with lichen sclerosus, using methylene blue 2% and RL50® source and the analysis of clinical responses.

**Study:** 26 women with vulvar lichen sclerosus were recruited from Centro de Referência e Saúde da Mulher-Hospital Pêrola Byington’s Colposcopy Department between 4/2009 and 9/2009. All cases of lichen sclerosus were diagnosed after vulvoscopy and biopsy. Median age was 55.7 years and time range of pruritus was 6 months to 20 years. Photodynamic treatment: All patients received intraleisional injection of an aqueous solution of 2% MB with 2% lidocaine. The light source used in this study was a non-laser lamp, red light (RL50®) wavelength of 750 nm, the dose of light was 100 J/cm² and time of exposition of 25 minutes.

**Results:** 21/26 (80.8%) patients reported itch improvement after 2 to 6 applications. After 10 applications 19/26 (73%) patients showed trophism response. Following 21 patients for 8 months no recurrence of symptoms by modifying the local immune response.

#139

**ABLATIVE FRACTIONAL LASER AND METHYL AMINOLEVULINATE: IMPORTANCE OF LASER DENSITIES, DRUG CONCENTRATION AND INCUBATION TIME**

Christina S. Haak, Kåare Christiansen, Andres M. Erlendsson, Elisabeth H. Taudorf, Daniel Thaysen-Petersen, Merete Haedersdal

**Background:** Pretreatment with ablative fractional lasers enhance the uptake of topical photosensitizers, but limited information is available on optimal laser densities, drug concentration and incubation time. By surface fluorescence measures, we evaluated the influence of varying laser densities, drug concentration of methyl aminolevulinate (MAL) and incubation time.

**Study:** The study was conducted on the backs of 11 healthy male volunteers. Test areas were pretreated with a fractional Er:YAG laser delivering 11.2 mJ/laser channel at densities of 0, 1, 2, 5, 10 and 15%. MAL concentrations of 80 mg/g and 160 mg/g and placebo cream were applied under occlusion. Surface fluorescence intensities (a.u.) were measured at 0, 30, 60, 120 and 180 min. after cream application. Fluorescence data were standardized and presented as percentages of each person’s maximum fluorescence accumulation.

**Results:** Surface fluorescence significantly increased after laserpretreatment with 1% density from 17% to 65% (MAL 80 mg/g) and 34% to 70% (MAL 160 mg/g) at 180 min. (0% vs. 1%, P < 0.0001). Laser densities up to 5% further increased fluorescence accumulation to 92% (MAL 80 mg/g) and 91% (MAL 160 mg/g) (P < 0.042). From 5 to 15% coverage fluorescence intensities were similar (P > 0.147). MAL 80 mg/g and 160 mg/g induced similar fluorescence levels in skin pretreated with densities from 1 to 5% at all incubation times (P > 0.071). After 5% laser pretreatment and a median incubation time of 80 min. (range 46–133 min., MAL 80 or 160 mg/g), fluorescence levels were similar to skin treated with curettage and 180 min. MAL 160 mg/g incubation.

**Conclusion:** Skin surface fluorescence increases with laser densities up to 5%, but no further accumulation is found with higher densities. Similar fluorescence is induced by MAL 80 mg/g and 160 mg/g at densities from 1 to 5% and the standard incubation time can potentially be reduced.

#140

**NOVEL DELIVERY OF PHOTODYNAMIC THERAPY FOR ACTINIC KERATOSIS IN ORGAN TRANSPLANT RECIPIENTS: COMBINATION OF ABLATIVE FRACTIONAL LASER, METHYL AMINOLEVULINATE AND DAYLIGHT ENHANCES EFFICACY AND MINIMIZES PAIN**

Katrine Tøgsverd-Bo, Ulrikke Lei, Andrés Erlendsson, Elisabeth H. Taudorf, Hans Christian Wulf, Lone Skov, Merete Haedersdal

**Background:** PDT is well-established for actinic keratosis (AK) and field cancerization, but struggles with inferior efficacy in organ transplant recipients (OTR) and painful treatments. We intended to improve the delivery of PDT, using a combination of ablative fractional laser resurfacing (AFXL), methyl-aminolevulinate (MAL) and daylight. The aim was to evaluate the efficacy of AFXL-assisted daylight PDT (AFXL-PDTday) compared to daylight PDT (PDTday), conventional PDT (PDTconv) and AFXL alone (AFXL) in field-directed treatment of AK in OTR.

**Study:** In each patient, four symmetrical skin areas were randomized to receive a single treatment with (i) PDTconv; (ii) PDTday; (iii) AFXL-PDTday, and (iv) AFXL. AFXL was delivered with a 2940 nm erbium laser at 5.6 mJ /laser channel, 2.4% density. MAL 16% cream was used as photosensitizing agent. In PDTday and AFXL-PDTday, MAL was incubated for 2½ hours without occlusion during daylight exposure (2 hours). For PDTconv, MAL was left under occlusion for 3 hours followed by red light emitting diode-light at 37 J/cm² at 630 nm. Primary endpoint was complete lesion response (CR) at 3 months after treatment.
Results: 16 OTR with a total of 542 AKs in field-cancerized skin of the scalp, chest and extremities were treated from August – September 2012. AFXL-PDTday was significantly more effective than PDTday and PDTconv. CR of all AK was 74% after AFXL-PDTday compared to 50% (PDTday), 48% (PDTconv) and 0% (AFXL) (P < 0.01). The laser procedure induced no or minimal pain (median 0). Pain sensation during AFXL-PDTday and PDTday was significantly lower (medians 0) compared to pain during PDTconv (median 4.5), (P < 0.001). Erythema and crusting were slightly more intense following AFXL-PDTday than PDTday and PDTconv. Transient hypopigmentation after AFXL-PDTday was observed in one patient.

Conclusion: AFXL-PDTday is a novel PDT modality that significantly enhances efficacy and tolerability compared to PDTday and PDTconv in difficult-to-treat AK in OTR.

#141

A SPLIT FACE EVALUATION OF A NOVEL TOPICAL OXYGEN EMULSION ON THE HEALING PROCESS FOLLOWING PHOTODYNAMIC THERAPY: A PILOT STUDY

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Background: Photodynamic therapy (PDT) is a useful modality approved for the management of actinic damage and actinic keratoses (AKs). While it can be a highly effective modality for the management of the above, the recovery is painful with cosmetic disability characterized by oozing, crusting, edema, and erythema. These treatment effects limit patient acceptance and delay return to work. We describe the use of a novel topical oxygen emulsion (TOE) product’s effect on the healing process following PDT.

Study: Ten (10) patients with actinic keratoses on their face were enrolled ranging from 52 to 71 years of age and skin types I–III. Informed consent and photographs were obtained at baseline, immediately post PDT treatment, during the first week post treatment, and at regular intervals up to 12 months post treatment. Each patient was treated with a standard protocol for PDT treatment using levulanic acid (Kerastick-DUSA pharmaceuticals). A topical oxygen emulsion (TOE) product (Cutagenix-Cutagenesis, Lafayette, LA) was applied to the left face twice daily and Aquaphor was placed on the right half beginning immediately post PDT. Patients documented all applications and any differences in healing including post treatment symptoms of burning, stinging, and pain. Pre and post treatment photos were compared for degree and intensity of erythema, edema, and efficacy of treatment was based on lesion counts.

Results: All patients reported positive benefit in healing and symptom reduction. Photographic analysis documented striking reduction in erythema and edema. Efficacy of PDT results were equal based on lesion counts.

Conclusion: A novel TOE proved extremely effective in reducing adverse symptoms, benefited healing, and did not reduce efficacy of PDT in this pilot split face study. All patients expressed a desire to use this TOE following future treatments for a speedier return to baseline activities including work. Future studies with more participants would be beneficial.

#142

DAYLIGHT PHOTODYNAMIC THERAPY: A REVIEW OF OUR EXPERIENCE WITH 40 CASES

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Background: Photodynamic therapy (PDT) is a safe and effective treatment for actinic keratoses and photoacinic damage. Three elements are needed for PDT: a photosensitizer, oxygen, and a light source. Conventional PDT is performed with a variety of different light sources: intense pulsed light (IPL), red light and blue light. Daylight PDT, using ambient visible light is safe, time and cost-efficient, and more comfortable for patients than other light sources. We report our experience with daylight PDT in 40 patients.

Study: Forty patients with photoacinic damage and actinic keratoses of varying degrees underwent one to multiple sessions with daylight PDT. Anatomic locations treated included face, arms, chest, and legs. Aminolevulinic acid (ALA) was applied one hour prior to light exposure. Thick actinic keratoses were gently curried prior to ALA application. Sun block (chemical blocker) was applied and patients sat outside in the shade for 2.5 hours. The following day, patients applied a chemical blocker and went into direct sunlight for 5 extra minutes. After the second exposure they were instructed to stay inside for 48 hours.

Results: All patients tolerated the procedure well. Patients and physicians noted significant reduction in photoacinic damage and actinic keratoses. Patients denied any pain during the first two and half hour exposure. The second day exposure elicited a mild burning sensation that patients rated as a 5–7/10. Patients appreciated the convenience of the treatment. There were no significant adverse events, and no patients reported scarring.

Conclusion: Daylight PDT achieves good functional and cosmetic outcomes with subjective reduction in actinic keratoses and photoacinic damage. Patients report less pain than conventional PDT and enjoy the convenience of treatment. Additionally, the cost of the procedure is significantly reduced, with ALA being the only expense. It was also noted to be a safe procedure with no significant adverse events or scarring noted.

#143

TREATMENT PLANNING OF NON-MELANOMA SKIN CANCER WITH MULTIMODAL IMAGING

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Background: The treatment of non-melanoma skin cancer (NMSC) is usually by excision or Mohs micrographic surgery and alternatively may include photodynamic therapy (PDT). To guide surgery and to optimize PDT, information about the tumor structure, optical parameters and vasculature is desired.

Study: Spatial frequency domain imaging (SFDI) can map optical absorption, scattering and fluorescence parameters that can enhance tumor contrast as well as quantify light and photosensitizer dose. Multi-wavelength analysis can provide maps of tissue oxygen saturation (StO2) and total hemoglobin concentration (THC). Photoacoustic imaging (PAI) can provide high-resolution, depth-resolved vascular maps. High frequency ultrasound (HFUS) imaging can provide high-resolution tumor structure and depth. Non-invasive measurements were compared to H&E and CD31 stainings of excised tumor sections.

Results: We show results from 20 patients. SFDI quantified optical parameters with high precision and multi-wavelength analysis enabled 2D mappings of tissue StO2 and THC. HFUS
PRE-TREATMENT WITH TOPICAL 5 FLUOROURACIL (5-FU) ENHANCE THE EFFICACY OF ALA PDT FOR THE TREATMENT OF ACTINIC KERATOSES; RESULTS OF A RANDOMIZED, CONTROLLED CLINICAL TRIAL WITH POST-TREATMENT 5-FU CHALLENGE

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Background: Both topical 5 FU and ALA PDT are FDA approved for the field treatment of actinic keratosis. Our experience suggests that 6 days of pretreatment with topical 5 FU followed by ALA PDT with a 2 hour incubation is both practical to administer and highly effective with an attractive side effect profile. We suggest a re-challenge of topical 5 FU using the widely held assumption that erythematous reactions to this agent by clinically normal skin represent subclinical AKs. We initiated a clinical study to prove these observations.

Study: This is an Investigator blinded randomized study in which 30 patients were randomized 1:1:1 into three groups. Twice topical daily 5 FU for 6–7 days, ALA PDT with a 2 hour incubation or 6–7 days of topical 5 FU followed by ALA PDT with a 2 hour incubation period. AK counts were performed at 24 hours, 1 week, 1 and 3 months after treatments and after a 6 day 5 FU re-challenge at month 3.

Results: Significant but similar reductions of AK’s were seen in all 3 groups at all points. However after the 5 FU re-challenge there were significantly fewer presumptive subclinical AKs in the combination 5 FU + PDT group as compared with the numbers observed in the other 2 arms. All groups had a similar and well tolerated side effect profile.

Conclusion: These data suggest that the combination of topical 5 FU ALA-blue light PDT is more effective than ALA-blue light PDT or a short course of topical 5 FU in the treatment of subclinical AK’s, which appeared with a 5FU re-challenge. The combination of pretreatment 5 FU plus ALA- blue light PDT is safe and selective for the treatment of AK’s.

PHOTODYNAMIC THERAPY FOR THE TREATMENT OF HEAD AND NECK MALIGNANCIES

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Background: Head and neck squamous cell carcinoma is the 5th most common malignancy. Treatment options consist of surgery, radiation or chemotherapy with their associated short term and long term morbidities. PDT is a minimally invasive anticancer therapy that has been demonstrated to be effective in the treatment of various cancers. This study evaluates the effectiveness of Photofrin PDT in the treatment of squamous cell carcinoma of the head and neck.

Study: Five hundred six patients with neoplastic diseases of the larynx, oral cavity and pharynx have been treated with Photofrin PDT with follow-up to 60 months.

Results: Those patients with primary or recurrent carcinoma in situ and T1 carcinomas obtained a complete response after one PDT treatment and 88% remain free of disease. Patients with T2 and T3 carcinomas treated with PDT obtained a complete response but in most cases they recurred locally, many with normal overlying mucosa. This is due to the inability to adequately deliver laser light to the depths of the tumor despite aggressive use of interstitial implantation. Intraoperative adjuvant PDT was used in 19 patients with recurrent head and neck cancers and only two developed local recurrence.

Conclusion: PDT is effective for the curative treatment of early carcinomas of the head and neck. It may also be of benefit as an adjuvant intraoperative treatment of large recurrent tumors.
Photodynamic Therapy (PDT) is variably effective against micro-organisms depending on the class of photosensitizer, gram staining nature of the bacteria, biofilm age and other factors. It is known that microbes inhabiting biofilm are protected from host influences and antimicrobial agents. PDT has been demonstrated to kill bacteria effectively in planktonic culture and in some biofilm models. The ultimate fate of the biofilm structure itself is crucial to the success of treatment. Here we studied the ability of aPDT to kill significant numbers of microbes within the biofilm and also the effect aPDT has on the architecture of the biofilm matrix.

Study: Cultures of various gram negative and gram positive bacteria were grown on titanium plates and germanium prisms to enable biofilm formation. PDT was carried out by incubating the plates with either an anionic or cationic photosensitizer for a prescribed time (5–30 minutes). Illumination was performed using the appropriate wavelength dictated by the sensitizer. Evaluation of killing efficacy was performed using an Alamar blue assay and colony forming unit assay. Multiple attenuated internal reflection infrared spectroscopy (MAIR-IR) and SEM were used to analyze samples pre and post PDT for validation. Jet impingement techniques were employed to determine detachment resistance of treated and control biofilm.

Results: aPDT resulted in significant reductions of bacteria in dose dependent manner for test conditions used. Biofilm changes and destruction were characterized with MAIR-IR with specific changes in composition detected post aPDT and jet impingement. Spectral analysis demonstrates biofilm structural component destruction follow a dose dependent effect.

Conclusion: The results indicate the killing efficacy of aPDT on both gram negative and gram positive bacteria. The data also demonstrate that aPDT has a profound effect on, and can be used to eradicate biofilm formed by various microorganisms.

ANTIMICROBIAL PHOTODYNAMIC THERAPY FOR THE TREATMENT OF CHRONIC RHINOSINUSITIS

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Background: Chronic recurrent sinusitis (CRS) is an inflammatory disease of the facial sinuses and nasal passages. The National Institute for Health Statistics estimates that CRS is one of the most common chronic conditions in the United States affecting an estimated 37 million Americans. It is also estimated that CRS results in 18–22 million office visits per year and over 500,000 emergency visits per year resulting in an estimated 73 million restricted activity days with an aggregated cost of six billion dollars annually. In clinical practice there is a significant subpopulation of patients with CRS who remain resistant to cure despite rigorous treatment regimens including surgery, allergy therapy and prolonged antibiotic therapy. The reason for treatment failure is thought to be related to the destruction of the sinus mucociliary defense by the chronic sinus infection resulting in the development of secondary antibiotic resistant microbial colonization of the sinuses and biofilm formation. Antimicrobial photodynamic therapy (aPDT) is a non-antibiotic broad spectrum antimicrobial treatment that has been demonstrated to eradicate antibiotic resistant bacteria and biofilms. This study was performed to demonstrate the in vitro and in vivo effectiveness of aPDT for treatment of chronic sinusitis.

Study: In vitro efficacy studies on the eradication of polymicrobial antibiotic resistant biofilms commonly associated with CRS using MB aPDT were performed in a maxillary sinus model. A human case study series to demonstrate safety and evaluate the efficacy on patients with recalcitrant CRS was performed with 6 month follow up.

Results: MB aPDT was effective in significantly reducing (P < .001) polymicrobial antibiotic resistant biofilms after a single treatment. Limited human studies demonstrate safety and early efficacy of the therapy in CRS patients.

Conclusion: MB aPDT can effectively treat CRS polymicrobial antibiotic resistant biofilms in vitro. Early human case studies demonstrate the potential efficacy of aPDT to treat CRS. Controlled human clinical trials are underway.

PHOTODYNAMIC DOSE FOR FOUR COMMERCIAL LIGHT SOURCES AND FOR DAYLIGHT PDT

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Background: Photodynamic therapy (PDT) is an effective treatment for actinic keratoses and Bowen's disease. We have developed a validated Monte Carlo Radiation Transfer (MCRT) model to compute the distribution of light in tissue.

Study: The model calculates photodynamic dose (PDD) in units of 1O2 cm2/C0 generated in a tumor assuming uniform distribution of protoporphyrin-IX.

Results: Light at 600 nm is only 10% as effective as light at 405 nm for a tumor of depth 1 mm but at 3 mm 630 nm is 23 times more effective than 405 nm. Four commercial light sources were compared; the photodynamic dose at a depth of 2 mm from the Aktilite LED and the Paterson light sources were at least 2.5 times greater than from the Waldmann 1200 and Photocure light sources. We have also investigated daylight as an alternative light source, modeling both direct light from the sun and the scattered light from the sky. Our model predicts that a photodynamic dose can be delivered to a depth of 2 mm after either 30 minutes exposure to daylight or 10 minutes exposure to the Aktilite LED.

Conclusion: The MCRT simulation reveals benefits and limitations of alternative commercial PDT light sources. It also supports the use of daylight as a PDT light source.

PRECLINICAL IN VIVO COMPARISON OF PHOTODYNAMIC THERAPY ON NORMAL VASCULATURE

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We performed a total of 60 experiments. We determined radiant exposures required to achieve persistent vascular shutdown. In this study, we evaluated the efficacy of three photosensitizers: NP6 (talaporfin sodium), BPD (benzoporphyrin derivative monoacid ring A), and Hemoporin (hematoporphyrin monomethyl ether (HMME)). We previously have investigated NP6- and BPD-mediated PDT for treatment of PWS, and Hemoporfin-mediated PDT is the most widely used PDT-based treatment for PWS.

**Study:** For NP6-mediated PDT, we activated the photosensitizer with two light sources. We investigated both a LED source (664 ± 20 nm) and a laser (664 nm). For BPD-mediated PDT, we studied two lasers (576 nm and 690 nm). For Hemoporfin-mediated PDT we used a 532 nm laser. We used the mouse dorsal window chamber model and laser speckle imaging to monitor blood-flow dynamics following PDT. In this study, we defined a successful treatment outcome as achieving persistent vascular shutdown within the window, seven days following PDT treatment. We used dose-response analysis to identify characteristic radiant exposures required to achieve persistent vascular shutdown at seven days following irradiation.

**Results:** We performed a total of 60 experiments. We determined the NP6 characteristic radiant exposure to be 85 J/cm² for LED irradiation and 108 J/cm² for laser irradiation. With BPD, we determined the characteristic radiant exposures to be 153 and 63 J/cm² for 576 and 690 nm wavelengths, respectively. For Hemoporfin, we determined that a much larger light dosage was needed to induce persistent vascular shutdown within our animal model compared to NP6- and BPD-mediated PDT. We identified specific classes of responses in the combined PDT treatments: no vascular shutdown, acute vascular shutdown followed by gradual restoration of blood flow, and acute vascular shutdown that persisted over the seven-day monitoring period.

**Conclusion:** Our data suggest that the microvascular effects of PDT depend considerably on photosensitizer. Further studies are expected to elucidate the difference in microvascular response.

#151

**A NEW ALGORITHM FOR SIMULATING LIGHT PROPAGATION IN TUMORS DURING INTERSTITIAL PHOTODYNAMIC THERAPY**

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**Background:** The objective of this work was to develop an algorithm for simulating light propagation throughout a tumor during interstitial Photodynamic Therapy (iPDT) treatment. The purpose of this work is to allow the physician to administer the prescribed light to the target tissue.

**Study:** A geometry that represents the target tumor is reconstructed from two-dimensional scans of a tumor obtained from computed tomography (CT) imaging, prior to therapy. The iPDT treatment is simulated by using cylinders of 2 mm in diameter at various lengths to represent the laser fibers. The entire geometry (fibers and tumor) is imported into a finite element modeling software (COMSOL 4.3b, Comsol AB Stockholm, Sweden). Our previously developed and verified diffusion model is used to calculate light propagation in the tumor. The calculation time is minimized by optimizing the mesh size. This algorithm was tested by obtaining data from three patients with head and neck cancer amenable for iPDT. The computer simulations are performed on a laptop computer.

**Results:** Tumor geometries were segmented to reconstruct the three-dimensional computer model. The geometries were successfully meshed for performing the finite element simulations. The calculations were completed within 1.5 minutes. The algorithm enables the visualization of the light dose distribution in 3D and in cross-sectional layers along the tumor. The effects of potential overtreatment and undertreatment are readily visualized. The simulations suggest that 100% of the tumor will receive the prescribed light dose.

**Conclusion:** This method of finite element analysis has the potential to assist the physicians in administering a prescribed light dose to the target tumor during iPDT.

#152

**TARGETING THE EPIDERMAL GROWTH FACTOR RECEPTOR TO SENSITIZE TUMORS TO PDT**

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**Background:** Combining PDT with molecular targeting drugs to alter the post-therapy angiogenic environment is well documented to improve therapeutic outcomes. Alteration of the tumor vasculature with antiangiogenic drugs prior to the delivery of radiation or chemotherapy can also be therapeutically advantageous by improving drug delivery to the tumor or its oxygenation. We have undertaken studies of molecular and microenvironmental mechanisms that can be modulated to augment cellular response to PDT, with a focus on inhibition of the epidermal growth factor receptor (EGFR) prior to initiation of PDT. The EGFR pathway can be overactive in many malignancies, leading to changes in angiogenic and survival signaling that favor tumor growth and resistance to therapy.

**Study:** Studies were conducted in tumors propagated from several established cells lines with varying levels of EGFR expression. Using a small molecule tyrosine kinase inhibitor of EGFR (erlotinib), the effects of molecular targeting on tumor microenvironment before and after PDT were evaluated. Measured outcomes included short-term assays of vascular function and cellular damage and monitoring of long-term therapeutic effectiveness.

**Results:** The pre-PDT administration of erlotinib could abrogate EGFR phosphorylation in tumor and endothelial cells that activated this pathway in response to PDT. This was accompanied by increased cure rates in animals that received both erlotinib and PDT, compared to PDT alone. Similarly, erlotinib increased tumor and endothelial cytotoxicity as well as vascular damage in tumors that received PDT.

**Conclusion:** Targeting the EGFR pathway prior to PDT can lead to improvements in the therapeutic effectiveness of PDT for several tumor types. Further studies are planned to investigate the clinical suitability of this approach for treatment at sites of interest in ongoing and planned clinical trials of PDT.

#153

**PDT INDUCED MICROVASCULAR CHANGES IN SKIN CANCER ASSESSED BY PHOTOACOUSTIC MICROSCOPY**
**PDT-INDUCED BLOOD FLOW CHANGES IN THE HEAD AND NECK CANCER OF ORAL CAVITY: AN UPDATE**

Daniel Rohrbach, Nestor Riguat, Erin Tracy, Michele Cooper, Kenneth Keymel, Hassan Arshad, Heinz Baumann, Barbara Henderson, Ulas Sunar

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**Background:** Photodynamic therapy (PDT) is an attractive treatment option for head and neck cancer. We implemented a Phase I clinical trial of HPPH mediated PDT for early stage head and neck cancers. We used HPPH as a PDT photosensitizer. PAM measurements were performed before, during and after treatment to quantify HPPH-PDT induced changes in the microvasculature. Diffuse Correlation Spectroscopy (DCS) measurements were also performed to measure changes in relative blood flow (rBF).

**Results:** Pre-PDT scans revealed tortuous abnormal vasculature in the ear even for the cases of unestablished or invisible tumors. After 1 minute of PDT, there was a visible vascular shutdown, which was supported by a 33% decrease in rBF. After 10 minutes of PDT, the shutdown was almost complete and rBF showed a 60% decrease.

**Conclusion:** The system has high resolution, which allowed mapping microvascular changes induced by HPPH-PDT. Blood flow changes supported the observed vascular shutdown. The techniques may be useful in investigating vascular mechanisms of PDT.

**IMAGE-GUIDED TWO-PHOTON PDT OF FADU HEAD AND NECK TUMOR XENOGRAFTS**

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**SensoPath Technologies, Inc.; Montana State University, Bozeman, MT; University of Florida, Gainesville, FL**

**Background:** Targeted two-photon PDT is a promising new technology for treating deep subcutaneous tumors in the Near-infrared tissue transparency window. For the treatment of FaDu Head and Neck cancers, the EGF receptor is a recognized target, and SensoPath Technologies has designed, synthesized and tested a therapeutic triad that incorporates a small targeting peptide, a Near-infrared imaging agent and a porphyrin that can be effectively two-photon activated at 800 nm.

**Study:** Scid mice bearing FaDu xenograft human H&N tumors averaging 1 cm diameter were treated using pulsed irradiation from a regeneratively amplified Ti:sapphire laser employing 100 fs pulses at 800 nm. Surface hair was removed prior to the irradiation procedure. The tumor was imaged prior to the initiation of the irradiation protocol, and the captured image was used to establish an ‘optical margin’ of 2 mm beyond the tumor image boundary, equivalent to a ‘surgical margin’ employed in typical conventional treatments. The triad was administered by intratumoral injection 4 hours pre-PDT, and then irradiated (including the 2 mm tumor margin area) by rastering the laser focus throughout the tumor volume in 1 mm increments using 900 mW pulses. On average, the irradiation protocol could be completed in ca. 20–25 minutes.

**Results:** In this protocol tumor regression was measured every 3–4 days following treatment. In our initial experiment, the tumor regressed 85% in 5 days, and the tumor was totally destroyed in 18 days. No tumor re-growth was observed after 41 days post-PDT. Hair re-growth was essentially complete at 41 days, and there was no visible scarring of the skin surrounding the irradiation area. There was no evidence of treatment toxicity pre- or post-PDT, and recovery was robust.

**Conclusion:** Targeted image-guided two-photon PDT is an extremely effective method of treating H&N tumors with no observed deleterious side effects.

**INFLAMMATORY PROPERTIES OF 5-AMINOLEVULINIC ACID: AN IN VITRO SYSTEM TO STUDY PHOTODYNAMIC THERAPY UTILIZING NARROW-BAND BLUE LIGHT**

Andrea Hui, Wei-Li Lee

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**Background:** 5-aminolevulinic acid photodynamic therapy (ALA-PDT) utilizing narrow-band blue light (NBBL) has demonstrated safety and efficacy in the treatment of acne vulgaris. Previous in vitro studies have shown that NBBL has anti-inflammatory effects on keratinocytes by decreasing cytokine-induced production of IL-1a and ICAM-1. Our objective was to
investigate the effect of ALA-PDT on the inflammatory process in the presence and absence of cytokines using IL-1α and ICAM-1 as markers for inflammation.

**Study:** Two keratinocyte cell lines were compared: hTERT and NHEK. Cells were treated with various doses of ALA, exposed to NBBL (420 nm at 54 mJ/cm²) and treated with INF-γ and TNF-α. Cell viability was determined by MTT assay. The expression of IL-1α and ICAM-1 was measured by quantitative ELISA.

**Results:** The results showed that ALA with and without NBBL treatment of hTERT and NHEK cells resulted in upregulation of cytokine-induced production of IL-1α. The level of IL-1α induction increased by 2- to 3-fold when hTERT and NHEK cells were exposed to ALA and cytokines, and similar increases were seen when NBBL was added. ICAM-1 expression was similarly increased. NBBL was unable to decrease cytokine-induced production of IL-1α when ALA was present as a photosensitizer. Additionally, while ALA itself is not cytotoxic, ALA-PDT is significantly cytotoxic to keratinocytes.

**Conclusion:** This study showed that ALA-PDT utilizing NBBL has a pro-inflammatory effect on keratinocytes by increasing the cytokine-induced production of IL-1α and ICAM-1. These results extend the properties of ALA-PDT as a modulator of inflammatory processes.

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**PRELIMINARY IN VITRO STUDY FOR USING RIBOFLAVIN-5 MONOPHOSPHATE AS A PHOTODYNAMIC THERAPY AGENT**

Istvan Stadler, Andrew Claffey, Solomya Blekot, Raymond Lanzafame

**Background:** Photodynamic therapy has proven to be a very useful approach in the struggle against cancer. There is still much work to be done to take the full benefit of this modality despite significant progress in this field. Chemical, physical, biological and clinical knowledge contributions are still required to fully understand the putative PDT mechanism and make this modality more widely useful. The aim of this *in vitro* study was to demonstrate that Riboflavin-5 monophosphate (vitamin B2) can be a photodynamic therapy agent using blue light to activate-PDT on HEp-2 and CRL 1472 (human bladder cancer) cell lines.

**Study:** HEp-2 and CRL 4172 cells (ATCC, Manassas, VA) were cultured in DMEM, 10% FBS, and SPF using 24 well cell culture plates. Riboflavin-5 monophosphate (RB, Sigma, St. Louis, MO) in PBS solution was added to the cultures in concentrations of 0, 0.0625, 0.125, 0.25 and 0.5 mg/ml. Four experimental groups were created: Group RBLT: received Riboflavin and photo-activation (LED LLLT at 457 nm at 10 mJ/cm² for 5 minutes); Group CTRL: cells were untreated; Group RB: received RB only without LLLT; Group LT: Received LLLT only without RB; Group CTRL: cells were untreated.

**Results:** Inhibition percentage of cell proliferation of HEp-2 and CRL 1472 in the presence of RB 24hrs post photo-activation is shown: RB conc mg/ml 0.0625 0.125 0.25 0.5 HEp-2 0 28.7 ± 5.0 51.0 ± 6.0 54.0 ± 5.0 87 ± 4.3 CRL-1472 0 48.0 ± 3.0 57.0 ± 5.0 76.0 ± 3.0 91.2 ± 4.0 *P < 0.05* (t-test, 2 tail, non-equal variance, t = 7.3 critical t = 2.77) no inhibition in cell proliferation.

**Conclusion:** This study supports the concept that the biocompatible compound riboflavin can be used as a photodynamic therapy agent. More *in vitro, in vivo* studies are warranted to prove the clinical relevance of this paradigm.

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**PHOTOBIOMODULATION**

#157

**LIGHT EMITTING DIODE-GENERATED BLUE LIGHT MODULATES FIBROBLAST PROLIFERATION, MIGRATION SPEED AND REACTIVE OXYGEN SPECIES**

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**University of California-Davis, Sacramento, CA**

**Background:** Skin fibrosis is a characteristic finding in multiple skin diseases of varied pathogenesis, including scleroderma, keloids, hypertrophic scars, and chronic graft-versus-host disease. Skin fibrosis is characterized by increased fibroblast proliferation, migration speed, and extracellular matrix deposition. We previously found that light emitting diode (LED) red light can alter human skin fibroblast proliferation and migration rate. Here we hypothesized that 415 nm LED blue light (LED-BL) can modulate fibroblast proliferation, migration speed, and may be mediated by reactive oxygen species (ROS) modulation.

**Study:** To test these hypotheses, normal adult human skin AG13145 fibroblast cells (Coriell) were irradiated using commercially available LED-BL (Photomedex). Each treated plate was matched with a temperature regulated “bench control plate” (BCP), to ensure that the measured effect was a result of LED-BL treatment and not due to other environmental factors. We assessed cellular proliferation by cell counting. Cellular migration speed was measured by time-lapse video microscopy imaging over a period of 4 hours at 30-minute intervals. We assessed LED-BL–induced modulation of reactive oxygen species generation measured by dihydororhodamine-123 (DHR) as analyzed by flow cytometry. Statistical analysis of data was performed using Student’s *t*-test and ANOVA.

**Results:** LED-BL at fluences of 30 J/cm² and 80 J/cm² significantly decreased cell proliferation at 48 hours post-irradiation (55.1% and 51.7% decrease compared to BCP, respectively, *P < 0.01*). LED-BL fluences of 30 J/cm² and 80 J/cm² decreased fibroblast migration speed by 18.7% and 67.7% of that of BCP (*P < 0.01*), respectively. A fluence of 80 J/cm² significantly increased ROS levels by 7.8% (*P < 0.05*) in irradiated fibroblasts compared to BCPs.

**Conclusion:** LED-BL modulates human skin fibroblast functions associated with fibrosis. We envision that our findings will serve as the foundation for future translational studies that contribute to light-based management of fibrotic skin disease.

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#158

**EFFECT OF LLLT ON THE LEVEL OF ATP AND ROS FROM CULTURED ORGAN OF CORTI CELLS OF RATS**

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**Dankook University College of Medicine and Medical Laser Research Center, Cheonan-si, Korea**

**Background:** Skin fibrosis is characterized by increased fibroblast proliferation, migration speed, and extracellular matrix deposition. We previously found that light emitting diode (LED) red light can alter human skin fibroblast proliferation and migration rate. Here we hypothesized that 415 nm LED blue light (LED-BL) can modulate fibroblast proliferation, migration speed, and may be mediated by reactive oxygen species (ROS) modulation.

**Study:** To test these hypotheses, normal adult human skin AG13145 fibroblast cells (Coriell) were irradiated using commercially available LED-BL (Photomedex). Each treated plate was matched with a temperature regulated “bench control plate” (BCP), to ensure that the measured effect was a result of LED-BL treatment and not due to other environmental factors. We assessed cellular proliferation by cell counting. Cellular migration speed was measured by time-lapse video microscopy imaging over a period of 4 hours at 30-minute intervals. We assessed LED-BL–induced modulation of reactive oxygen species generation measured by dihydororhodamine-123 (DHR) as analyzed by flow cytometry. Statistical analysis of data was performed using Student’s *t*-test and ANOVA.

**Results:** LED-BL at fluences of 30 J/cm² and 80 J/cm² significantly decreased cell proliferation at 48 hours post-irradiation (55.1% and 51.7% decrease compared to BCP, respectively, *P < 0.01*). LED-BL fluences of 30 J/cm² and 80 J/cm² decreased fibroblast migration speed by 18.7% and 67.7% of that of BCP (*P < 0.01*), respectively. A fluence of 80 J/cm² significantly increased ROS levels by 7.8% (*P < 0.05*) in irradiated fibroblasts compared to BCPs.

**Conclusion:** LED-BL modulates human skin fibroblast functions associated with fibrosis. We envision that our findings will serve as the foundation for future translational studies that contribute to light-based management of fibrotic skin disease.
**Background:** It is well established that ototoxicity may induce damage of cochlear hair cells and hearing loss. Previous studies using transcranial LLLT (Low level laser therapy) on animal model with hearing loss induced by ototoxicity demonstrated that LLLT promoted recovery of hearing loss and cochlear hair cell damage. However, its mechanism has not been studied. **Aim:** The aim was to investigate the mechanism of hearing recovery by LLLT. **Study:** HEI-OC1 (House ear institute organ of Corti) cells were cultured for 24 hours. The cultured cells of GM groups were treated with 6.6 mM and 13.1 mM of gentamicin (GM) for 4 hours. Cultured cells were divided into 6 groups, No treatment, LLLT only, GM 6.6 mM, GM 13.1 mM, GM 6.6 mM + LLLT, and GM 13.1 mM + LLLT groups. LD laser (808 nm), 15 mW was irradiated to the cultured cells for 15 min. immediately and 1 hour post GM treatment. ATP was assayed using the ATP assay Kit. ROS was measured by intensity of dye using confocal microscope after application of H2DCFDA dye. **Results:** ATP was decreased in GM 6.6 and 13.1 mM cells, increased in LLLT only cells, GM 6.6 mM - LLLT, and GM 13.1 mM + LLLT cells compared to GM 6.6 and 13.1 mM groups. ROS was decreased in no treatment and LLLT only cells, increased in GM 6.6 mM and GM 13.1 mM cells, and decreased in GM 6.6 mM + LLLT and GM 13.1 mM + LLLT groups compared to GM 6.6 and 13.1 mM cells, immediately and 1 hour post laser irradiation. **Conclusion:** This study demonstrated that LLLT on GM treated HEI-OC1 cells increased ATP and decreased ROS that may contribute to the recovery of hearing loss and hair cell damage.

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**Conclusion:** By upregulating TH and BDNF mRNA expression and downregulating caspase-3 expression, RLED may inhibit H2O2-induced apoptosis of dPC12 cells, which might be stronger than the photobiomodulation inhibition on cellular apoptosis in proliferation-specific medium.

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**A STUDY OF THE EFFECTS OF LLLT USING RED AND NIR WAVELENGTH LEDS ON ACUTE INFLAMMATION IN A RODENT MODEL**

**Raymond Lanzafame, Istvan Stadler, Carol Gell, Danielle Macario**

**Raymond J. Lanzafame, MD PLLC; Rochester General Hospital, Rochester, NY; Johnson & Johnson Consumer and Personal Products, Skillman, NJ**

**Background:** The present study investigated the effect of low level light therapy (LLLT) on the acute inflammatory process in a standard model of acute inflammation. **Study:** Male Sprague Dawley rats (N = 48, 250–450 g) were sedated with 50%CO2: 50%O2. Rats received subplantar injection of carrageenan (0.1 mL, 1% suspension in saline) in the hind paw. Paw edema (mL) was measured using a Model 7140 Ugo Basile plethysmometer immediately before and 1, 2, 3, and 4 hours after injection. The change in paw volume was calculated by subtracting the baseline volume from the final volume. The area under the time-course curve (AUC; mL/h) was calculated using the trapezoidal rule. Blinded LLLT was delivered using coded LED devices at a single point in contact with the paw (80 sec/treatment). SSO (660 nm, n = 6); ETO (830 nm, n = 6); ENO (890 nm, n = 6); NFO (940 nm, n = 6); Saline control (n = 6), lambda carrageenan (n = 12). Devices were set to a power output of 5 mW, a power density of 70.7 mW/cm2 and energy density of 5.7 J/cm2. Rat paws were treated at 1, 2, and 3 hours. post-injection. The SSO2 group was also treated immediately post injection (0, 1, 2, 3 hours). **Results:** All LLLT groups demonstrated significantly less inflammation (P < 0.05) compared with carrageenan at 1 and 4 hours and at 2 hours for Saline, 660 nm, and 940 nm, and at 3 hours for Saline, 660 nm, 890 nm, and 940 nm. Administering 660 nm LED treatment immediately after carrageenan injection was not salutary in reducing edema. The AUC for each wavelength was significantly lower than carrageenan. 660 nm and 890 nm were the most effective. **Conclusion:** LLLT significantly reduced acute inflammation in this model. Treatment with 660 nm immediately after injury did not yield additional benefit. Further studies to optimize treatment intervals, wavelengths, and parameters such as pulsing and the use of multiple wavelengths in specific sequences are warranted.

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**LOW LEVEL LIGHT THERAPY CAN IMPROVE WOUND HEALING IN AN EXPERIMENTAL MODEL OF CHRONIC KIDNEY DISEASE**

**John Kevin Hix, Stephen Silver, Istvan Stadler, Jamie Bucher, Sumangaly Thambiaiyah, Jeff Blackman, Ralph Pennino**

**Rochester General Hospital; Sahler Animal Lab Rochester, Rochester, NY**

**Background:** Chronic kidney disease (CKD) is a possible contributor to delayed wound healing although the mechanism is unclear and studies are mixed as to whether this is a result of CKD...
or a manifestation of malnutrition. Aim: To study the impact of CKD on wound healing in a rat model, and determine if LLLT at 670 nm with LED source can influence this process. Study: Male-Sprague Dawley rats (Charles River Laboratories International, Inc. Wilmington) underwent 5/6 nephrectomy or sham surgery (A: Sham) on day 0. On day 31, after the development of CKD, the animals underwent a wound dressing procedure in which five separate full thickness wounds (dm = 4.0 mm) were placed on the shaved and cleaned dorsum area using a standardized skin punch. Animals in the nephrectomy group were then divided into a standard treatment group (B: NT only) and a LLLT treatment group (C: NTLLLT). Group C received LLLT of 5 J/cm²/day of total energy (670 nm, 10 mW fluence rate) for 10 min., (Quantum Devices, Barneveld, WI) on days 32–46. Monitoring: Wounds were photographed and area calculated using IMAGEJ photo software (NIH) at day 31, 38, 46 post wounding. Blood urea nitrogen and creatinine was measured on the same days. On day 46, the subjects were euthanized. Results: Table 1: Comparison of the wound area (in sq mm) at days of post wounding Experimental Groups Day 0 Day 7 Day 16 Group A (sham) 13.54 ± 2.37 3.91 ± 3.11 0.28 ± 0.13 Group B (NT only) 13.07 ± 2.37 5.82 ± 3.21* 2.2 ± 0.33 Group C (NTLLLT) 14.14 ± 2.76 3.66 ± 3.12 0.39 ± 0.13 Statistical comparison: * significant difference P < 0.05 Group B vs Group C at 7 and 16 days pw. Conclusion: Based on the experimental study LLLT as specified improved the wound healing in 5/6 nephrectomy model. Further detailed studies for the better understanding of the mechanism and for clinical relevancy is warranted.

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TRANSCRANIAL AND INTRAPARENCHYMAL LIGHT PENETRATION IN HUMAN CADAVER BRAIN TISSUE

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Background: The use of transcranial photobiomodulation for the treatment of brain requires an understanding of light propagation through scalp, skull, meninges, and brain. This study investigated light penetration gradients in human cadaver brains. Study: Cadaver heads (n = 8) were used with permission of the USUHS Anatomical Materials Review Committee. The heads were sectioned in the mid-sagittal or horizontal planes. The sectioned heads were mounted in a cranial fixture with an attached 808 nm wavelength laser (variable output power to 70 W, continuous wave (CW) or pulsed wave (PW) modes, cooled). Nine Medlight IP85 400 lm fibers with isotropic detectors were assembled into a 40 mm linear array and aligned with the laser. The array was lowered into the brain by 5 mm increments and position coordinates were recorded to establish transcranial light penetration at each fixed location and angle. Light penetration was measured with the laser operating in CW or PW modes (10 or 100 Hz, 20% duty cycle). For intraparenchymal brain tissue measurements, a multi-wavelength (660, 808 and 940 nm) emitter probe was used. Results: There was an exponential correlation of depth and light penetration across cadavers. Penetration of the 808 nm wavelength light (output power of 5 W) through the scalp, skull and meninges was detectable up to a depth of 40 mm in the brain. The fluence rate at a depth of 20 mm was 0.2–9 mW/cm² and at 40 mm was 0.002–0.08 mW/cm². There was no difference in the normalized fluence rates for the laser in CW or PW modes. 808 nm wavelength light had the best penetration within the brain tissue compared to the 660 and 940 nm wavelengths. Conclusion: Unfixed human cadaver tissues can be used to determine light penetration and fluence rates data for determining clinical dosing.

#164

CAN TRANSCRANIAL LOW-LEVEL LASER LIGHT THERAPY INDUCE THE BRAIN TO REPAIR ITSELF?

Michael Hamblin

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Background: A multitude of brain disorders could be benefited if the brain could be stimulated to heal and repair itself. Transcranial low-level laser light therapy (LLLT) at near-infrared wavelengths (810 nm) penetrates the scalp and skull and provides many beneficial effects to the brain. These include neuroprotection, anti-apoptosis, anti-inflammation, angiogenesis, neurogenesis and synaptogenesis. Study: We used mice that had received a traumatic brain injury either by a controlled cortical impact or by a closed head injury to test the beneficial effects of LLLT. Mice were followed with neurological severity score, wire grip test, forced swim test, tail suspension test, Morris water maze, and numerous immunofluorescence studies on brain sections removed at sacrifice. Results: The neurological functioning of mice was improved as demonstrated by the neurological severity score and the wire grip and motion test. Learning and memory improved as shown by the Morris Water Maze Test. Immunofluorescence studies in brain sections showed increased incorporation of BrdU in the hippocampus and subventricular zone as an indicator of neurogenesis - the formation of new brain cells. The pleiotropic neurotrophin – brain derived neurotrophic factor (BDNF) was increased at early time points while synapsin1 was increased at later time points indicating that new connections were being formed between existing neurons. Conclusion: The beneficial effects in stimulating neurogenesis, synaptogenesis and BDNF after transcranial LLLT suggest the treatment may have wider applications beyond TBI to neurodegenerative diseases such as Alzheimer’s and psychiatric diseases such as major depression.

#165

A STUDY OF THE EFFECTS OF ENERGY DENSITY AND RECIPROCITY OF EXPOSURE TIME AND IRRADIANCE DURING 880 nm LED LLLT vs DICLOFENAC ON ACUTE INFLAMMATION IN A RODENT MODEL

Raymond Lanzafame, Istvan Stadler, Carol Gell, Danielle Macario

Raymond J. Lanzafame, MD PLLC; Rochester General Hospital, Rochester, NY; Johnson & Johnson Consumer and Personal Products, Skillman, NJ

Background: NSAIDs and LLLT have been used to treat inflammation. The present study investigated energy density, reciprocity of exposure time and irradiance, versus diclofenac treatment on acute inflammation. Study: Male Sprague Dawley rats (N = 54, 250–450 g) were sedated with 50% CO₂ /50% O₂ and divided into groups of 6. Groups
PLAQUE CHARACTERIZATION

HYBRID OCT AND TWO-PHOTON LUMINESCENCE IMAGING SYSTEM FOR PLAQUE CHARACTERIZATION
Tianyi Wang, Jordan Dwelle, Austin McElroy, David Halaney, Derek Ho, Marc D. Feldman, Thomas E. Milner

University of Texas at Austin, Austin, TX; University of Texas Health Science Center at San Antonio, San Antonio, TX

Background: Atherosclerosis and plaque rupture leading to heart attack and stroke is the first killer worldwide. Plaque-based macrophages and lipid deposits are important early cellular markers that indicate plaque vulnerability. In vivo intravascular macrophage and lipid detection in the context of plaque structures with high spatial resolution, high sensitivity and specificity is potentially of great clinical significance.

Study: We present use of gold nanorods, providing superior two-photon luminescence (TPL) brightness, as a contrast agent to target macrophages in thin-cap fibroatheromas (TCFA) for TPL imaging. A hybrid optical coherence tomography (OCT)-TPL imaging system using a photonic crystal fiber (PCF) was used to detect plaque components such as macrophages, lipids, collagen and elastin fibers as well as plaque structures in TCFA samples. The OCT-TPL imaging system incorporates swept-source OCT (1310 nm) and TPL imaging (at 760–1040 nm excitation). A PCF was used to simultaneously transmit single-mode OCT/TPL excitation/emission light to/from the sample. Changes in paw volume were calculated by subtracting basal volume from the final volume. The area under the time-course curve (AUC; m/l/h) was calculated using the trapezoidal rule.

Results: LLLT at 880 nm and 3, 5, or 7 J/cm² significantly reduced acute inflammation (P < 0.05). The three tested energy densities were equally effective. Reciprocity of exposure time and irradiance was demonstrated over the range of parameters tested. Group L6 (100 sec at 50 mW/cm²) demonstrated the best response based on AUC analysis. Diclofenac yielded the greatest reduction in paw edema. However, in contrast to LLLT, its effect had subsided at 4 hours post injection.

Conclusion: LLLT at 880 nm significantly reduces acute inflammation in this model. Observed anti-inflammatory effects were more prolonged than diclofenac administration. Further studies to optimize treatment intervals and parameters are warranted.

Conclusion: Our results suggest that such hybrid OCT-TPL imaging is a promising technique to detect plaque component and structure simultaneously in TCFAs.

#167
EVALUATION OF LOW-LEVEL LASER THERAPY AT 635 nm FOR THE TREATMENT OF ACUTE AND CHRONIC NECK AND SHOULDER PAIN: A PLACEBO-CONTROLLED, RANDOMIZED STUDY
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Background: Upper extremity chronic pain is a dynamic condition with a multifactorial etiology and a poorly understood pathogenic mechanism. The most prevalent form of upper extremity pain is chronic shoulder and neck pain (cSNP), which affects 10–36% of the population at some point. Low-level laser therapy (LLLT) has demonstrated preliminary utility for the treatment of acute and chronic pain. Herein, we evaluated the efficacy of LLLT delivering a wavelength at 635 nm with an output intensity of 1.0 mW for the relief of cSNP.

Study: Eighty-six subjects qualified and were enrolled in a placebo-controlled, randomized, double-blind, multi-center study. Degree of Pain rating was recorded using the VAS with 0 representing “no pain” and 100 representing “worst pain imaginable.” Linear range of motion (ROM) was performed to assess patient mobility in the neck-sholder region using a universal inclinometer. Participants were evaluated across four time points: pre-procedure, immediately post-procedure, and at 24 and 48 hours post-procedure. An individual patient success criterion was defined as a 30% improvement in Degree of Pain rating on the VAS across the two measurement periods.

Results: Of the 43 participating test patients, 28 (65.1%) met the individual success criteria with 11.6% of placebo subjects satisfying the criteria, a difference of 53.5% in the proportion of individual participants meeting the success criteria between test and sham groups. Test group participants reported a reduction of −29.02 for immediate post-procedure Degree of Pain ratings on the VAS (P < 0.0001), compared with a 4.91 reduction on the VAS for control subjects. (P > 0.05). Test group participants demonstrated a significant improvement in linear range of motion for the right and left sides of the neck and right and left sides of the shoulder.

Conclusion: These data demonstrate the clinical utility of LLLT at 635 nm for the treatment of cSNP.

#168
EVALUATION OF LOW-LEVEL LASER THERAPY AT 635 nm FOR THE TREATMENT OF CHRONIC PLANTAR FASCIITIS: A PLACEBO-CONTROLLED, RANDOMIZED STUDY
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Background: Plantar fasciitis affects close to one million people in the United States. A majority of cases are successfully treated with conservative therapies; however, roughly 10% of cases require surgical intervention. A newly emerging technology, low-level laser therapy (LLLT), has demonstrated promising results for the treatment of acute and chronic plantar fasciitis. LLLT...
modulates cell function, yielding analgesic and regenerative effects.

**Study:** Sixty-nine subjects qualified and were enrolled, from 09/2011 to 06/2013, in a placebo-controlled, randomized, double-blind, multi-center study evaluating LLLT for the treatment of unilateral chronic fasciitis. Volunteer participants were treated twice weekly for three weeks, for a total of six treatments and were evaluated at five separate time points: pre-procedure; procedure weeks 1, 2, and 3; and, on post-procedure days 21 and 35. Degree of pain was recorded using a visual analog scale (VAS), with zero representing “no pain” and 100 representing the “worst pain imaginable”. Doppler ultrasound was performed on the plantar fascia to measure fascia thickness and circulation (blood flow). Study participants also completed the Foot Function Index (FFI).

**Results:** Test group participants demonstrated a mean improvement in the heel pain VAS of ~29.58, compared with sham subjects, who reported a mean improvement in the heel pain VAS of ~5.38 (P < 0.001). Plantar fascia thickness was significantly reduced in test group subjects (P < 0.005), but not in sham participants. A satisfaction questionnaire reported a statistically significant difference in the proportion of “Satisfied” responses between LLLT and sham-treated patients (P = 0.0001).

**Conclusion:** Although further studies are warranted, these data demonstrate that LLLT is a promising treatment for plantar fasciitis. No adverse events were reported.

# SURGICAL APPLICATIONS/INTERSITIAL LASER THERAPY

**#172**

**ARBORIZING CATHETER FOR FIBEROPTIC TOOLS IN THE BRAIN**

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**Background:** We have developed an arborizing catheter to deliver multiple slender cannula, optical fibers, or other surgical tools to precise locations deep within the brain via a single needle tract, enabling deployment in a distributed pattern that would otherwise require multiple risky insertions.

**Study:** The arborizing catheter was manufactured by pre-arranging PEEK tubing (0.031in OD/0.015 in ID) on 0.015 in spring steel wire using a custom frame. Seven tubes were arranged with one in the center and the remaining six equally spaced about a 20 mm radius. The tubes were coated with epoxy, and the outer tubes were wrapped around the central tube at a helical angle of ~25. After curing, excess epoxy was removed with a 30 μm lapping film, and the tip ground to a 30 cone with a lapping wheel. This device was implemented during a demonstration of photothermally augmented convection-enhanced delivery in an ex vivo canine brain. Deployment of hollow-core fiberoptic microneedles through the arborizing catheter into the brain was demonstrated using CT and MR imaging.

**Results:** The manufacturing process described above yields a device up to 10 cm long with an outer diameter of approximately 2.5 mm. The needles deploy at a 25° angle from the catheter's axis, with no lateral motion due to actuation. The deployed fiberoptic needles are clearly visible in the brain via CT imaging, and the enhanced infusion volume is seen in MR images.

**Conclusion:** This device allows multiple optical fibers, temperature or pressure sensors, or slender capillary tubes to be guided through a single needle tract, and deploying them in the target area. This minimizes the risk of damaging critical structures due to multiple insertions, or seeding multiple needle tracts with cancer cells or other diseased tissue.

**#173**

**LASER-ASSISTED BODY CONTOURING WITH A NOVEL FIBER FOR TARGETED ENERGY DELIVERY: A NEW MODALITY FOR SIMULTANEOUS TREATMENT OF SKIN AND ADIPOSE TISSUE**

Christine Petti, Jacqueline Stoneburner, Laura McLaughlin

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**Background:** Suction-assisted lipectomy, combined with various adjunctive technologies such as ultrasound, power-assisted and laser-assisted modalities have been the gold standard treatment for body contouring. The contour deformities treated by these lpectomy techniques commonly coexist with skin surface irregularities - known as cellulite. The lpectomy techniques are effective in addressing the conditions of lipodystrophy; however, have failed to address the surface deformities of cellulite.

**Study:** The purpose of this study is to determine the efficacy a new fiberoptic laser technology that is tissue-specific and anatomically-targeted to the deformities of lipodystrophy, skin dimpling and skin laxity as a single, simultaneous treatment. In 2012, 15 subjects with noticeable cellulite, Grade II and Grade III, accompanied by mild to moderate lipodystrophy of the lower body received single treatments of the Nd:YAG laser at a wavelength of 1440 nm along with the 1000 micron side-firing fiber optic laser system for simultaneous treatments of both lipodystrophy, elastosis and cellulite. Patients were assessed at baseline and 3 months post treatment by a modified Nurnberger-Muller scale utilized to quantify the cellulite severity. Additionally, patient satisfaction and a global aesthetic improvement scale were used to measure the improvement in lipodystrophy.

**Results:** The average modified Nurnberger-Muller scale score at baseline was 5.1 (+/- 0.8) and the average improvement was 2.2 (+/- .7). Five patients completed 3-month follow-up at the time of this abstract and the remainder will be evaluated and presented. Paired t-test showed statistically significant results from baseline. Global aesthetic improvement scores ranged from 2 to 3 (2.1 average) indicating a much-improved overall appearance in the subject population. Reviewers could also identify the correct baseline Photo 87% of the time when presented with a set of photos.

**Conclusion:** Precise, effective delivery of laser energy to the dermal-adipose tissue, as well as the deep adipose lipodystrophy is now available as a safe modality for the simultaneous treatment of cellulite and lipodystrophy in the thighs and buttocks.
FEASIBILITY OF MODULATING HEALING TISSUE RESPONSE BY ITU (INTENSE THERAPY ULTRASOUND) IN MUSCULOSKELETAL TISSUE

Michael Slayton, Jennifer Barton
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Background: ITU effectively creates thermal injury zones inside soft tissue, initiating a tissue repair cascade in the skin, promoting collagen generation. It may be feasible to promote a robust healing response in musculoskeletal tissue accelerating healing from injury. Aim: Establish feasibility of generating healing response via ITU thermal injuries in live rabbit Achilles tendon model. Study: The rabbit studies were performed under protocol approved by IACUC, University of Arizona. Anesthetized animals were imaged with conventional ultrasound (Spark, Ardent Sound). The Achilles tendon of one limb was exposed and partially transected, the other tendon exposed only and served as an operative control. 24 hours post-surgery Achilles tendons were treated with ITU (Gen. 2, GTS). One set of 2 rabbits, 4 tendons represented 4 groups (cut or not, treated or not). At time points of 4, 14 and 24 days post-treatment the tendons were explanted and subjected to PCR to examine growth factors, cytokine and collagen gene expression. At time points 14 and 24 days tendons were mechanically tested to measure stress-strain curves and rupture strength. Five sets of rabbits (20 tendons) were sacrificed: 1 at 4 days, 2 each at 14 and 24 days. At all time points the limbs were ultrasonically imaged and recorded.

Results: Results of PCR showed significant increase of the growth factors (TGF-?), inflammation related interleukin-1 beta (IL1?) and expected reduction and increase respectively between collagen type 1 and collagen type 3. Ultrasound images showed complete tendons' recovery at time points of 24 days when treated with ITU. Mechanical testing showed no remarkable difference between treated and cut group vs. uncut group in measurements of stress and rupture.

Conclusion: Feasibility of initiating a healing cascade in musculoskeletal tissue in live animal model was demonstrated utilizing ITU. Mechanical testing for stress-strain and rupture showed no compromise in ITU treated tendons.

PHOTODYNAMIC REMOVAL OF RECTAL MUCOSA IN A POSTOPERATIVE PATIENT WITH RESIDUAL MICROSCOPIC CANCER AFTER ULAR

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Changsha, China; Changsha, China

Background: Positive surgical margin is a bad news for either surgeons or patients particularly in regard of rectal carcinoma. It is difficult for the surgeon to decide whether to perform extended resection especially Mile’s operation. This report is the first to describe the successful treatment of photodynamic removal for residual microscopic cancer among rectal mucosa from the distal end of an anastomosis cut ring after uLAR. Study: A 56 year old male diagnosed of high-grade dysplasia with rectal tumor biopsy was admitted to our hospital. A 2 × 2 × 2 cm² rectal tumor 4 cm above dentate line was removed using ultra-low anterior resection (uLAR) 1 cm above the line. Pathological analysis revealed a moderately-differentiated adenocarcinoma. The patient refused further major surgery. Due to intolerance to chemotherapy (FOLFOX6), he finally received a Porphyrin-based PDT treatment. The patient was given 2 mg/kg porphyrin via venous injection. After 48 hours, the patient was treated with 630 nm laser-based PDT in two 20-min irradiations separated by a 10-min interval. The power intensity was 100 mW/cm². We used a 4 cm long fiber to cover the anastomotic stoma (1 cm) and the distal end of the anastomosis (3 cm).

Results: The patient suffered no side effects from PDT. A mucosa circle removed by the photodynamic irradiation was shed through the anus approximately 3 weeks after PDT. A random rectal biopsy 8 months after PDT showed no signs of recurrence.

Conclusion: This clinical case demonstrated that photodynamic therapy can be a good choice of minimization of positive surgical margins. We conclude that PDT may be a backup remedy for patients with rectal cancers who failed traditional therapies and may even serve as a regular post-surgery treatment for advanced rectal cancers on account of its high risk of local recurrence.

LOW LEVEL LASER THERAPY PREVENTS COMPLICATIONS POST LAMINECTOMY

Vanessa Holanda, Benedito Pereira, Kelly Ferreira, Flavia Greiffo, Jean Oliveira, Cristiane França, Daniela Silva, Miguel Ontanedo, Nathali Pinto, Maria Cristina Chavantes
Beneficiencia de Sao Paulo Hospital; Noive de Julho University Sao Paulo, Brazil

Background: Each year, more than one million individuals worldwide are submitted to laminectomies, with a failure rate higher than 40%. Post-laminectomy epidural adhesion is implied as a main cause of “failed back surgery syndrome” and associated with increased risk of complications during revision surgery. The post-operative epidural scar can cause extradural compression or dural tethering, which results in recurrent radicular pain and physical impairment. Several studies in the literature are signaling that Low Level Laser Therapy (LLLT) is proven to be an effective tool to assist the inflammatory process and wound healing, as well to prevent infection. Thus, the objectives of this project are to delineate and evaluate the LLLT effects in spinal surgery.

Study: A prospective randomized, controlled trial with a total of 46 patients who will be undergoing to laminectomy, will be divided into 2 groups. In 23 randomized patients, LLLT (B-Cure, Good Energies®, Israel), diode laser-semiconductor Gallium Arsenide and aluminum (GaAlAs) was applied during surgery (2 = 804 nm ± 2, total exposure time of 240 s, energy density of 2.48 J/cm², average power of 40 mW, spot area of 3.876 cm²), for 60 seconds on the laminecemy site, 60 seconds in the subcutaneous tissue and 120 seconds over the wound. In the second group, 23 patients were induced to think they were getting the same treatment, although LLLT was not operating. In those groups, C reactive protein (CRP), erythrocyte sedimentation rate, lactic dehydrogenase and creatine kinase (CK) were evaluated in the second and fifth days after surgery, digital temperature and visual analogue scale was measured, pre and post LLLT application. The drainage output was collected in the first and second days following surgery in both groups. Interleukins 1, 4, 6, 8 and 10 and tumor necrosis factor alpha were evaluated.
Background: Oral cancer causes 130,000 Indian and 8,500 U.S. deaths annually. Treated early, 5-year survival exceeds 80%. However, approximately 75% of oral cancers are detected as advanced disease, resulting in poor prognosis - typical 5-year survival rate is less than 20%. A critical need for early detection is for there is no simple, low-cost, non-surgical means of screening for oral neoplasia, especially in remote locations. Purpose: To develop a low-cost, portable wireless networked diagnostic system for oral cancer based on Optical Coherence Tomography (OCT), set up the necessary infrastructure for wireless-networked use in India and identify its diagnostic efficacy. Study: Existing OCT technology was completely re-engineered and a simple diagnostic algorithm indicating further diagnostic and treatment needs for each lesion developed. Based on these parameters ex vivo and in vivo imaging data were obtained and compared with conventional histopathology to determine diagnostic accuracy. Patients will be recruited and imaged in the field. Images are organized by patient ID number and uploaded to a third party wireless system (Dropbox), which automatically synchronizes via Drobo system on both ends. Images are then read at UCI or MSCC for clinicopathological follow-up. Results: A compact, inexpensive, robust, wireless-enabled OCT system was built. A support network with collaborators was developed addressing logistics, data acquisition and data transmission. Diagnostic-quality intra-oral images were successfully obtained. Different algorithmic approaches were evaluated for their agreement with conventional histopathology. A simple approach using reflectivity and thickness ratios of superficial anatomical structures provided excellent diagnostic sensitivity (.85%) and specificity (>82%). Conclusion: Using an innovative portable OCT-coupled wireless device and simple diagnostic algorithm, early detection of oral and mucosal epithelial cancers is possible. Funding: AFOSR FA 9550-10-1-0538; NIH 1RO3EB01-4852; NIH/NIBIB P41EB015890, UCI-SURP.
dimensions of the voids. A mixture of Rhodamine and Polyethylene Glycol was injected into the voids under a fluorescent stereoscope to monitor success of localization.

**Results:** Measured ablation threshold fluences were 0.6 and 0.4 J/cm² for healthy and scarred pouches with 3-ps, 776 nm laser pulses delivered at 303 kHz. Scarred pouches exhibited 30% lower threshold, possibly due to the degraded mechanical properties of scarred collagen during wound healing. Also, we have successfully demonstrated localization of the biomaterial into the ablated subepithelial void of 2 × 1 mm² in a scarred pouch. The presence of sub-epithelial voids provides a space for the biomaterial, which greatly reduced back-flow at the injection site and resulted in a lasting localization of the injected biomaterial.

**Conclusion:** Ultrafast laser ablation assisted biomaterial injection can enable surgeons to improve the localization of injected biomaterials for the treatment of vocal fold scarring.

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**#180**

**Q-BAND EPR DOSIMETRY FOR TOOTH ENAMEL BIOPSY SAMPLES**

Prabhakar Misra, Tania De, Alexander Romanyukha, Barry Pass

Howard University, Washington, DC; Community College of Baltimore County, Catonsville, MD; Uniformed Services University of the Health Sciences, Bethesda, MD

**Background:** X-band EPR (8–12 GHz) has long been established for dose reconstruction of tooth sample doses 0.1 Gy or higher; however this technique requires a relatively large amount (~100 mg) of tooth enamel and dentin samples to be extracted. Q-band EPR (33–50 GHz) can measure smaller sample amounts (~2 mg) that retain crystalline structure and maintain anisotropy. In order to effectively use Q-band EPR with fast dental biopsy techniques, EPR measurements are optimized with enhanced sensitivity and spectral resolution in order to compensate for anisotropy. This research investigates the accuracy and sensitivity of Q-band measurements on tooth enamel biopsy and dentin samples as small as 2.2 mg with radiation dosages in the range 0–12.9 Gy.

**Study:** An enamel biopsy technique was developed to extract small enamel pieces (~2 mg) from the tooth crown with the least amount of blemish in the crown and which allows for subsequent restoration utilizing light-cured composite resins to restore the crown damage. This technique ideally complements Q-band measurements, which only require small samples. A Bruker ELEXSYS E500 EPR spectrometer was used to carry out EPR experiments in the Q-band on the samples collected through this technique.

**Results:** The shape of the radiation-induced signal (RIS) in enamel chips in Q-band is different from those recorded for powder samples and has higher signal-to-noise ratio. The radiation-induced Q-band EPR spectral features were clearly resolved from the native background signal.

**Conclusion:** In conventional X-band measurements, the RIS EPR signal overlaps with the native background signal. In contrast, Q-band measurements of these signals were distinguishable and thereby the dose reconstruction process was much easier.

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**#181**

**EFFECT OF CO₂ LASER AND FLUORIDE DENTIFRICE ON DEMINERALIZATION AROUND ORTHODONTIC BRACKETS: AN IN SITU STUDY**

Livia Rodrigues, Thais Parisotto, Carolina Steiner-Oliveira, Lidiany Azevedo, Cinthia Tabechoury, Marinos Nobre-dos-Santos

UNICAMP, Sao Paulo, Brazil; Fortaleza, Brazil

**Background:** Verify whether the irradiation of carbon dioxide (CO₂) laser with a wavelength of 10.6 μm and density of 20.0 J/cm² combined with the use of an orthodontic adhesive could reduce enamel demineralization around orthodontic brackets.

**Study:** 80 human third molars were cut into 160 specimens of 5 × 5 × 2 mm, which were divided into the groups. During two phases of 14 days each, 20 volunteers used a device intraoral palatal containing four specimens of human enamel, which were randomly divided into 4 groups: 1- Adhesive + Non Fluoride Toothpaste (NFT) (control), 2- CO₂ Laser + Adhesive + NFT, 3- Adhesive + Fluoride Toothpaste (FT) and 4- CO₂ Laser + Adhesive + FT. Volunteers dripped on the slabs a 20% sucrose solution eight times a day at predetermined times. After each phase, the biofilm around the brackets was collected and the fluoride concentration in the dry biofilm was analyzed. The mineral loss around orthodontic brackets was determined by cross-sectional microhardness measurement. The results of the fluoride concentration in dried biofilm were analyzed by Lilliefors and Kruskal-Wallis test followed by the Student Newman-Keuls test (α = 0.05) and the results of the mineral loss were analyzed by Lilliefors test followed by ANOVA.

**Results:** Regarding the fluoride concentration in the dry biofilm, the groups 3 and 4 showed a higher fluoride concentration in the biofilm than those observed for groups 1 and 2.

**Conclusion:** The adhesive system was showed to be effective in reducing demineralization in situ around orthodontic brackets and the presence or absence of CO₂ laser and fluoride toothpaste showed to have no influence on the enamel mineral loss around orthodontic brackets.

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**#182**

**OPTICAL APPROACH TO EVALUATING THE EFFECTS OF A NOVEL DENTAL GEL ON ORAL BIOFILM**

Sara Sabokpey, John Biren-Fetz, Tatiana B. Krasieva, Mohammad Dadkhah, Na Eun Chung, Janet Ajdaharian, Cherie Wink, Petra Wilder-Smith

Beckman Laser Institute and Medical Clinic, University of California, Irvine, CA; School of Dental Hygiene, Concorde Career College, Garden Grove, CA

**Background:** There is a need for a means of non-invasively assessing the effects of oral hygiene measures in the oral cavity. The goal of this study was to develop a technique for non-contact microvisualization of oral biofilm after using a novel dentifrice in vivo and then to validate this capability by investigating the effects of the test gel in vivo.

**Study:** For the ex vivo study, saliva was collected from a healthy donor. From the fifteen samples used, one untreated sample, one test gel treated sample and one control gel treated sample were incubated in saliva for 3, 6, 12 and 24 hours respectively. Control samples were incubated in sterilized water. After incubation, each sample was stained for bacteria and also for pellicle formation. Multiphoton microscopy (MPM) was used to visualize the presence of pellicle and biofilm in each sample. The results from this study show that after 3 hours of ex-vivo incubation bacterial plaque start to colonize but the test gel treated samples showed the least biofilm formation and uninterrupted pellicle. In order to validate the
effects of the test gel on gingival health in vivo, twenty-five subjects with moderate gingival inflammation and pocket depths <4 were randomly assigned to brush twice daily for 21 days with the test or the control gel. On Days 0, 7, 14 and 21, one blinded, investigator using a pressure sensitive probe determined plaque levels, gingival inflammation, and gingival bleeding. In vivo Optical Coherence Tomography (OCT) imaging was also used.

Conclusion: Non-invasive imaging is an effective tool for mapping oral biofilm development and removal.

#183

DIAGNOSTIC PERFORMANCE OF LASER FLUORESCENCE AND OCT IN A DENTAL OFFICE SETTING

Stephanie Mansour, Janet Ajdaharian, Tasneem Nabelsi, Gregory Chan, Brian Jow, Dillen Kohanchi

Petra Wilder-Smith, University of California, Irvine, CA

Background: The goal of this study was to compare the results of oral mucosal screening in a general dental practice using clinical observations and Optical Coherence Tomography (OCT). It was the objective of this study to compare diagnostic performance of OCT versus the current gold standard in 40 subjects.

Study: Forty patients in a local general dentist’s office were enrolled in this study. Enrollment was sequential over 1 week. Each patient underwent a full detailed mucosal examination by an experienced clinician, using visual examination and palpation according to standard clinical practice. Any mucosal areas of interest were examined according to regular standard of care, then imaged using OCT. Two blinded pre-standardized examiners reviewed OCT images and assigned a pathological diagnosis based on our database of >1000 OCT images.

Results: Using conventional examinations, 9 areas of interest were diagnosed including 6 red lesions and 2 white lesions. These were diagnosed respectively as 4 aphthous ulcers, 1 herpetic lesion, 1 lichen planus, 2 traumatic lesions, plus various stages of gingivitis and periodontitis. 1 palatal torus was also recorded. OCT images of these sites did not modify the diagnosis obtained by conventional means, but did confirm the suspicion of lichen planus, which was confirmed by biopsy and histopathology. Images also provided more detailed information on periodontal attachment structure and status.

Conclusion: These findings illuminate the challenges in developing novel approaches for improved oral mucosal diagnosis. Most lesions are benign and hence provide limited impetus to the general dental practitioner for the acquisition of novel diagnostic tools. Funding support: NIH 1R03EB01-4852; NIH/NIBIB P41EB015890, UCI-SURP

#184

PREVALENCE OF VERY EARLY TOOTH DECAY (DEMINERALIZATION) IN ACTIVE ADULTS AGES 65-74

Daniel Kohanchi, John Biren-Fetz, Sarah Chung, Sharif Mohammad, Petra Wilder-Smith, Jennifer Holtzman

Beckman Laser Institute and Medical Clinic, Irvine, CA; UCLA School of Dentistry, Los Angeles, CA

Background: Tooth decay in adults is a significant, largely preventable, health problem. Adults often lack access to or fail to use interventions that can control tooth decay. Older adults are particularly vulnerable to tooth decay due to increased medication utilization, decreased manual dexterity, and limited resources. Tooth decay can be arrested or reversed in children. We do not know if these interventions are effective in older adults. Establishing the prevalence of demineralization/very early tooth decay in older adults is a key step in developing caries prevention interventions in older adults.

Study: Overall goal of this study was to establish baseline prevalence data of early tooth decay in community dwelling active adults age 65–74. Evaluation criteria in 75 subjects included: standardized oral health literacy screening, visual dental examinations and charting. Additionally, coronal surfaces were scored using the International Caries Detection and Assessment System (ICDAS). Finally, non-invasive optical imaging, Optical Coherence Tomography (OCT) was performed to detect demineralization and early tooth decay not visible to the naked eye. OCT images were scored by 2 scorers and compared with ICDAS scores to determine diagnostic capabilities of the modalities.

Results: 75% of subjects demonstrated visual signs of demineralization or early decay (ICDAS 1 and 2) in at least one tooth as diagnosed by the most sensitive clinical index, the ICDAS system. OCT-based diagnosis showed closer agreement with ICDAS than with conventional clinical diagnosis, with the latter detecting fewest early lesions.

Conclusion: Demineralization and early decay were common in this population. Without preventive care, these areas have a high likelihood of progressive tooth decay requiring costly surgical treatment. Thus there exists an urgent need for prevention in this age group. OCT imaging and ICDAS provide an effective means of screening for such lesions and monitoring the effectiveness of preventive interventions. Funded by the National Institutes of Health under grant No. P41EB015890 (Laser Microbeam and Medical Program: LAMMP), IADR, and the Beckman Foundation.
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