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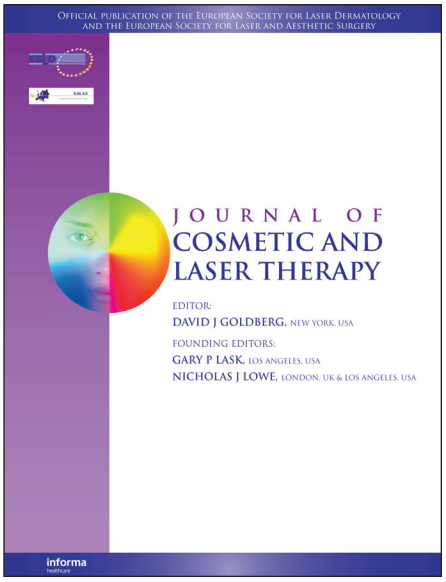

Fractional Q-Switched 1,064-nm Laser for the Treatment of Photoaged-Photodamaged Skin

Michael H. Gold, Whitney Sensing, Julie Biron

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Materials and Methods: Ten healthy female subjects (Age ranging 35-53 years, mean 44.3) and skin types I-IV) were diagnosed with mild-to-moderate facial photo-damage, hyper-pigmentation, tel-angiectasia, laxity, skin roughness and actinic keratosis. Subjects were treated with a new non-ablative fractional Q-Switched 1,064-nm Nd: YAG laser (Harmony XL, Alma Lasers Ltd.). Treatments consisted of 4 sessions at 2-4 week intervals. Follow-up (FU) visits were 1 and 3 months following the final treatment.

Results: Utilizing the Glogau scale, 6 Subjects were graded Type II (means wrinkles in motion), and 4 Subjects were graded Type III (means wrinkles at rest) at Baseline. At the FU2, 3-month post final treatment, 60% of the subjects were graded with at least a one-point improvement in the overall Glogau global assessment. Between baseline and FU2, Investigator assessments showed the following improvements: Hyperpigmentation 70%, Telangiectasias 80%, Laxity 80%, Tactile Roughness 60%, and AKs 60%. Pain assessment was reported between 0 to 2 in all treatments (scale 0-10). Of expected side effects, erythema was most common, occasionally being reported as high as a 2(scale 0-10). No unexpected adverse effects were reported.

Conclusion: The non-ablative fractional Q-Switched 1,064-nm Nd: YAG laser is safe and effective in improving signs of mild-to-moderate photodamage skin irregularities with no downtime, no pain to only minimal pain, and without any adverse side effects.

Fractional Q-Switched 1,064-nm Laser for the Treatment of Photoaged-Photodamaged Skin

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Introduction

Fractional photothermolysis has emerged as one of the most popular aesthetic treatments for the signs of photoaged and photodamaged skin. The concept of fractional photothermolysis is to injure only very small areas of the skin, leaving areas of healthy, normal skin next to the treated areas. The healthy skin will help the treated skin heal faster, thus making fractional therapies very popular in today's laser and aesthetic world.

Numerous medical devices, at varying wavelengths of light, are currently being used as fractional laser devices. These include the nonablative fractional lasers that utilize wavelengths of light between 1,440 nm up to 1,927 nm. Theses devices routinely require a series of treatments, usually between four and six, to achieve satisfactory results. Downtime associated with these devices varies; but typically, one to two days of downtime are common with the non-ablative devices. The most common ablative fractional devices have wavelengths of 2,790 nm(YSGG devices), the 2,940 nm (erbium: YAG lasers), and 10,600 nm (carbon dioxide lasers). The fractional ablative devices usually only require one or two treatments to achieve their aesthetic benefits, but are associated with more downtime. The downtime can range anywhere from 5-10 days, depending upon the aggressiveness of the treatment and the amount of thermal damage created during the treatment itself. As well, sublative fractional rejuvenation exists, which utilizes

radiofrequency energy to create its fractional effects. Downtime with these devices usually is between one and three days and several treatment sessions may be necessary to achieve the desired results. (1-5)

Over the years, subjects have utilized the 1,064-nm laser in various modes. As a near-infrared laser, this was utilized in years past as a nonablative rejuvenation therapy. Multiple treatments were required and, although there were histological changes noted as a result of these treatments, many could not see tangible results clinically. The Q-Switched 1,064-nm laser has found its place in laser medicine and is a standard for the treatment of deep pigment and for the treatment of tattoos. Multiple manuscripts have been written over the years that document their safety and efficacy. (6-8)

Recently, a 1,064-nm Q-Switched fractional device was introduced into the market. A recent pilot study, by Luebberding and Alexiades-Armenakas (9) showed that this device could improve superficial rhytides. A second study, by Tan, also showed the safety and efficacy of this device. (10) This clinical trial was designed to assess the 1,064-nm Q-Switched fractional laser in its ability to treat photoaged and photodamaged skin. This includes its effectiveness in improving skin color, skin texture, and tightening of age-related and sun-related damaged skin, including reduction in wrinkles, dyschromia, and to evaluate the overall recovery time, commonly referred to as downtime.

Materials and Methods

This was a single-center IRB-approved research project with all treatments being performed at The Tennessee Clinical Research Center, Nashville, TN. Ten healthy volunteers with skin types I-IV and photoaged- photodamaged skin were recruited for this clinical research project. The study was conducted in accordance with the International Conference on Harmonization (ICH) Harmonized Tripartite Guideline for Good Clinical Practice (GCP), 1996; the US Code of Federal Regulations (CFR) Title 21 parts 50, 56, and 812; applicable national laws and regulations and the ethical principles that have their origin in the Declaration of Helsinki.

The laser module utilized is known as the Pixel Q-Switched module (QSW) operated on the Harmony XL Multi-Applications Platform (Alma Lasers Inc., Buffalo Grove, IL). It was designed as a fractional Q-Switched lasers module using high peak power and short pulses in the nanoseconds domain. The Q-Switched 1,064-nm wavelength laser is only modestly absorbed in melanin and hemoglobin thus enabling it to have deep penetration into the papillary and reticular dermis. The laser is fractionated by a passive refractive optical element, creating a 5x5 matrix of 25 microscopic holes, each with a diameter of approximately 200um and distributed in a 5 mm by 5 mm footprint. The Pixel QSW creates a high energy density of each pixel (range 60-130 J/cm2) to facilitate a non-specific thermal injury of the dermis, which them promotes collagen remodeling, albeit with a short pulse duration in the nanosecond range, differentiating it from other fractional lasers. The Pixel QSW laser module is shown in Figure 1.

The energy settings of the Pixel QSW range between 400-1200 mJ/Pulse. The pulse repetition of the Pixel QSW is adjustable, from 1 Hz, 2 Hz, or 4 Hz. Because the near infrared wavelength of the Pixel QSW (1,064-nm), where blood and melanin absorption is low, and the low power output of each pixel (51 mJ/Pixel), the laser module is considered very safe.

Each of the ten participants was first required to sign an informed consent. Inclusion criteria in this study included males or females in good general health between 35 and 55 years of age with mild to moderate photoaged or photodamaged skin, which was determined by scoring a two or higher on the Glogau's 4-point photodamage scale.Exclusion criteria included those individuals with any uncontrolled systemic disease. Other exclusion criteria included the use of any topical product containing a retinoid, a retinal, or any other Vitamin A preparation within three months of entry into the clinical trial; the use of any systemic corticosteroid therapy within six months prior to the study; the use of a toxin or biostimulatory molecule within the previous six months; any topical medicated cream, lotion, or powder on the treatment area within 14 days before the start of the clinical trial and throughout the clinical trial; one year without the use of isotretinoin or its derivatives; excessive exposure to sunlight or UV light prior to and during the clinical study and follow up period. As well, any facial skin concern or disease that may interfere with the study also was an exclusion to participate in this clinical trial.

Each subject was scheduled to receive up to four treatments, administered at intervals of 14 +/- 2 days. Each subject had clinical photographs taken at baseline, prior to each treatment, and during each follow-up period. Further clinical evaluations were scheduled at one month and three months following the last treatment visit. Pain tolerance was assessed on a 0 (min) -10 (max) scale

Clinical assessment scales included the visual appearance of the treated area and from the fixed magnification of clinical photographs using the following scale: -1 for exacerbation; 0 for no change; 1 for 1%-25% improvement; 2 for 26% 50% improvement; 3 for 51% to 75% improvement; and 4 for improvement from 76% to 100%. At each clinical session, subjects were assessed for any signs of adverse events including erythema, edema, and burns of the skin. The Global Aesthetic Improvement Scale (GAIS) was also determined for each of the subjects in the clinical trial.

Each subject was given a skin test area of treatment prior to the full-face treatment. This was performed on the lower left or right side of the jaw-line and the nasolabial fold level. The skin test area was 2 x 5 cm and the treatment test site was performed according to the parameters outlined in Table I. After a wait period of 30 minutes, the treatment was conducted according to the parameters listed in Table II. Following each treatment, subjects were instructed to apply Cetaphil Cleanser (Galderma, Ft. Worth, TX), Cetaphil Moisturizers, and an SPF sunscreen with a 30+.

Subjects were evaluated for their amount of photodamage, the amount of hyperpigmentation present, the degree of telangiectasia present, the laxity of the skin, the roughness of the skin, and the numbers of actinic keratoses (AKs) present. At each visit, changes in these parameters were assessed.

Results

All ten of the subjects enrolled in the clinical completed the study and all of the follow-up visits. The age ranges were from 35 years of age to 53 years of age, with a median of 44.3 years. All of the participants in the clinical trial were females.

Utilizing the Glogau scale, six subjects were evaluated as Skin Type II with wrinkle in motions and four subjects were evaluated as Skin Type III, with wrinkles at rest. The clinical assessments, in graph form are seen in Figures 2-7 for each of

the parameters of photoaged-photodamaged skin that was assessed during the clinical trial.

From the tables provided, one can see that at the FU2 visit, which correlates to the three month following the last treatment with the Pixel QSW, 60% of the subjects were graded with at least a one-point improvement in the overall Glogau Aesthetic Improvement Scale, or GAIS. Between the baseline visit and the FU2 visit, or three month follow-up period, the investigator assessments showed the following improvements in the photoaged-photodamaged skin: there was a 70% improvement in hyperpigmentation during the course of the clinical trial; there was an 80% improvement in the telangiectasias the subjects presented with at baseline and the end results; skin laxity was noted to improve in 80% of the subjects with tightening noted in the treatment areas; tactile roughness improved in 60% of the subjects; and there was a 60% decrease in identifiable AKs from baseline to the end of the treatment and follow-up period.

Pain assessments were reported using a 0-10 scale and the pain reported by subjects across all the treatments was noted to be between 0 and 2. The pain, via graph form, is shown in Figure 8. Erythema, immediately following the treatments themselves, and lasting for several hours to 24 hours, was reported in the majority of individuals, being reported as high as a 2 on a 0-10 scale. No other expected or unexpected adverse events were noted during the course of this clinical trial. No subject experienced any significant downtime that caused her to miss a scheduled activity or to miss her work schedule.

A representative before and after clinical photograph is shown in Figure 9.

Discussion

Subjects are searching for real and visible clinical results when they visit an aesthetic dermatology clinic for the treatment of photoaged and photodamaged skin. A variety of therapeutic options are available and many show great safety and efficacy in achieving a satisfactory cosmetic outcome. The desire for treatment options which lower the downtime of subjects has become one of the top considerations, along with assessing the subjects' lifestyle and daily requirements, when determining the most appropriate therapy to deal with today's cosmetic's problems.

Fractional photothermolysis has been a boom for the past ten years as we have been able to treat subjects safely and with less downtime as compared to their full non-ablative or ablative predecessors. Non-ablative fractional therapies, which introduced the concept to the aesthetic community, paved the way to provide meaningful treatments with minimal downtime, although they usually require multiple treatments to achieve acceptable results. Ablative fractional treatments are also very useful, however keeping in mind that with this more aggressive form of therapy, more downtime is needed for the subjects, thus limiting the therapy in some instances. Sublative fractional therapy is also useful and many find it has approached ablative fractional as it lessens the associated downtime with the procedure.

Q-Switched 1,064-nm therapy has been around in the cosmetic arena for many years. It has shown to be the laser of choice for pigmented lesions and for the treatment of tattoos. Recently, a pixelated form of the Q-Switched 1064-nm has been introduced, which was the basis of the clinical trial described in this report.

The Pixel QSW stimulates new collagen formation through the induction of a micro-thermal injury in the dermis that initiates the wound-healing cascade. The dermal injury causes a proliferation of fibroblasts and an up-regulation of collagen expression (neocollagenesis /remodeling) that leads to a thicker and more normal appearing dermis. Both pro-collagen and type III collagen fibers are produced. This increases skin firmness and improves skin texture in subjects after the laser treatments.

Heat shock protein (HSP70) has been suggested to play a significant role in ablative and non-ablative thermal laser treatments (9). Nonablative laser treatments with a 1,540-nm Er-glass laser resulted in a uniform up-regulation of HSP70 protein expression in the epidermal layers immediately (about 60 min) after the laser procedure, with maximal expression one to three days post-intervention (10). This will play a role in new collagen formation with fractional laser therapy, including the Pixel QSW.

Luebberding and Alexiades-Armenakas reported on this device in 2012. (11) In their pilot study of seven individuals, they treated facial and neck skin aging with the Pixel QSW device. Their subjects received three treatment sessions at 2-4 week intervals and they evaluated the subjects one month following their last Pixel QSW laser treatment. Their results showed an 11.3% improvement over baseline for the rhytides of the face and neck. The subjects had no associated pain with the treatments given and they noted minimal erythema with the therapy as well. They concluded that the Pixel QSW significantly improves superficial rhytides and is a safe device for this therapy.

In a second clinical evaluation, Tan (12) evaluated 60 subjects with the Pixel QSW. Each subject received three weekly treatments with the Pixel QSW and was followed one week, one month, and three months following their last laser treatment. He found that 15% of the subjects had very significant clinical improvement (76-100%) and 22% had improvement between 51-75%. His study showed that the periorbital areas were the areas that responded best to the laser therapy and that the arms responded the least to this treatment.

The present study evaluated more parameters than superficial rhytides, as it was a fitting progression to evaluate how the device would work in treating photoaged and photodamaged skin, looking at a variety of parameters that are associated with photodamaged skin. The results presented confirm the work of the pilot study and suggest that using the Pixel QSW can result in improvement of photoaged and photodamaged skin with minimal downtime and virtually no pain, over a short period of time. Subjects and clinicians can notice improvement and this is important as we assess the true benefit of these therapies for the treatment of rhytides and photodamage.

Conclusions

The fractional Pixel QSW laser showed significant clinical improvement in the signs of photoaged and photodamaged skin with minimal downtime and minimal pain making it a useful and safe fractional modality for all skin types and those interested in cosmetic enhancements of their skin.

Declaration of interest: This study was sponsored by Alma Lasers. Dr. Gold has acted as a consultant and speaker for Alma Lasers and has received educational grants from Alma Lasers. Whitney Sensing is employed by the Tennessee Clinical Research Center. Julie Biron is employed by the Tennessee

Clinical Research Center. The Tennessee Clinical Research Center has received educational grants from Alma Laser.

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Table Legends

Table I

Pixel QSW Skin Test Parameters.

Skin Type (Fitzpatrick I-VI)	*Fluence (mJ/P)*	*Pulse Repetition Rate (Hz)*	*Total Energy (J)*	*Waiting Period (minutes)*
I – III	1000	4	400-500	30
IV-VI	800	4	400-500	30

Table II

Pixel QSW Laser Suggested Treatment Parameters

Skin Type	Energy (mJ/P)	Overlapping (%)	Frequency (Hz)	*Total Energy (J)	Intensity
I-III	800 – 1200	50-80	4	400-500	Mild
IV-VI	800-1000	50-80	2 or 4	400-500	Mild
I-III	800-1200	50-80	4	500-600	Moderate
IV-VI	600-800	50-80	2 or 4	500-600	Moderate
I-III	1000 -1200	50-80	4	600-650	Aggressive
IV-VI	600 – 800	50-80	2 or 4	600-650	Aggressive

Figure Legends

Figure 1

High Power Pixel QSW Nd: YAG 1064-nm laser hand piece and its 5x5 pixel matrix on a 0.5 x 0.5 cm footprint.

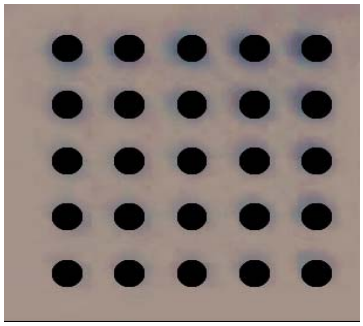

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Figure 2

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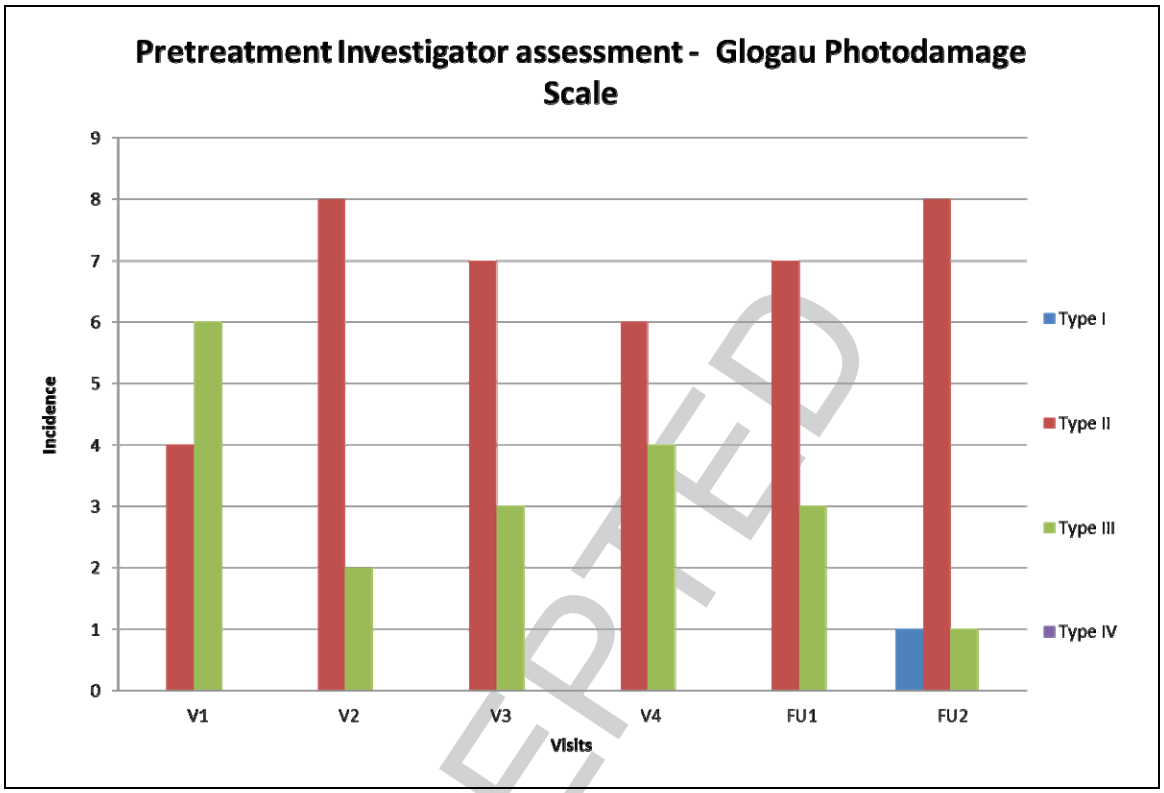

Figure 3

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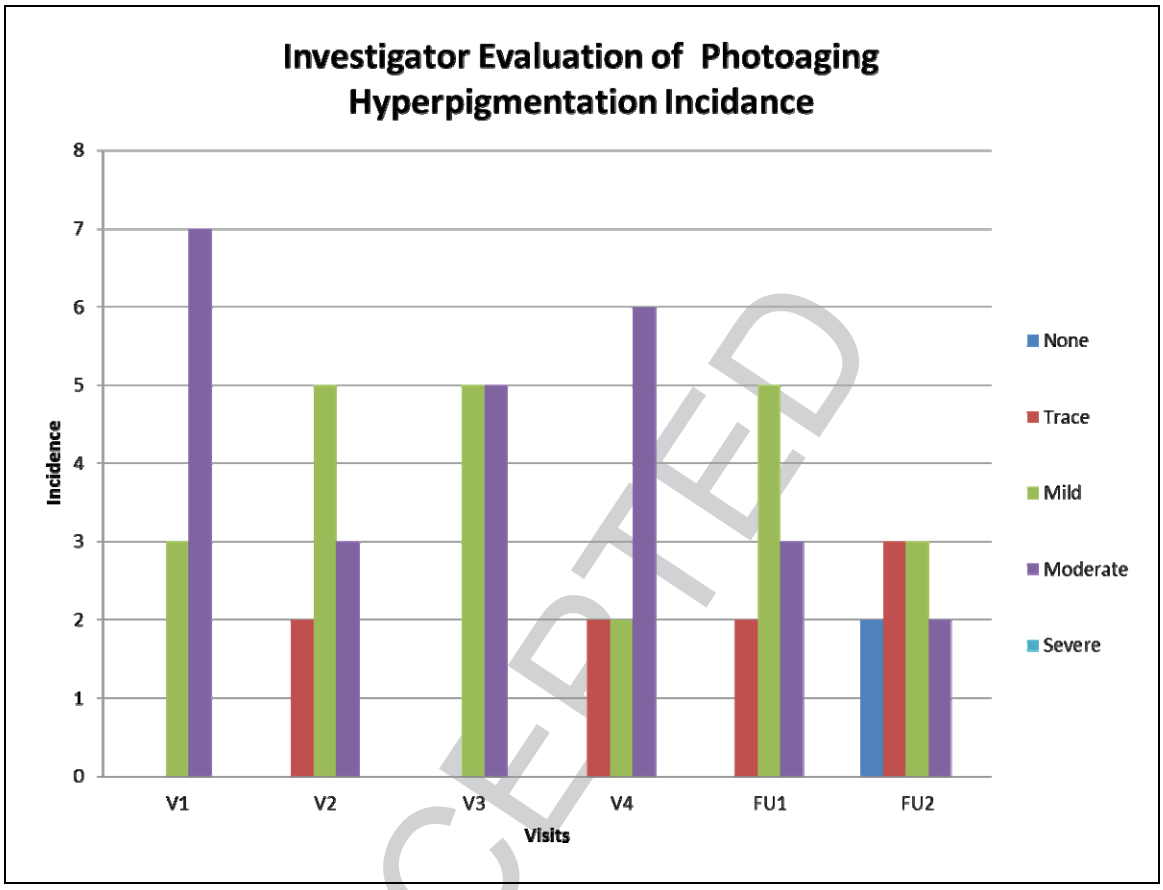

Figure 4

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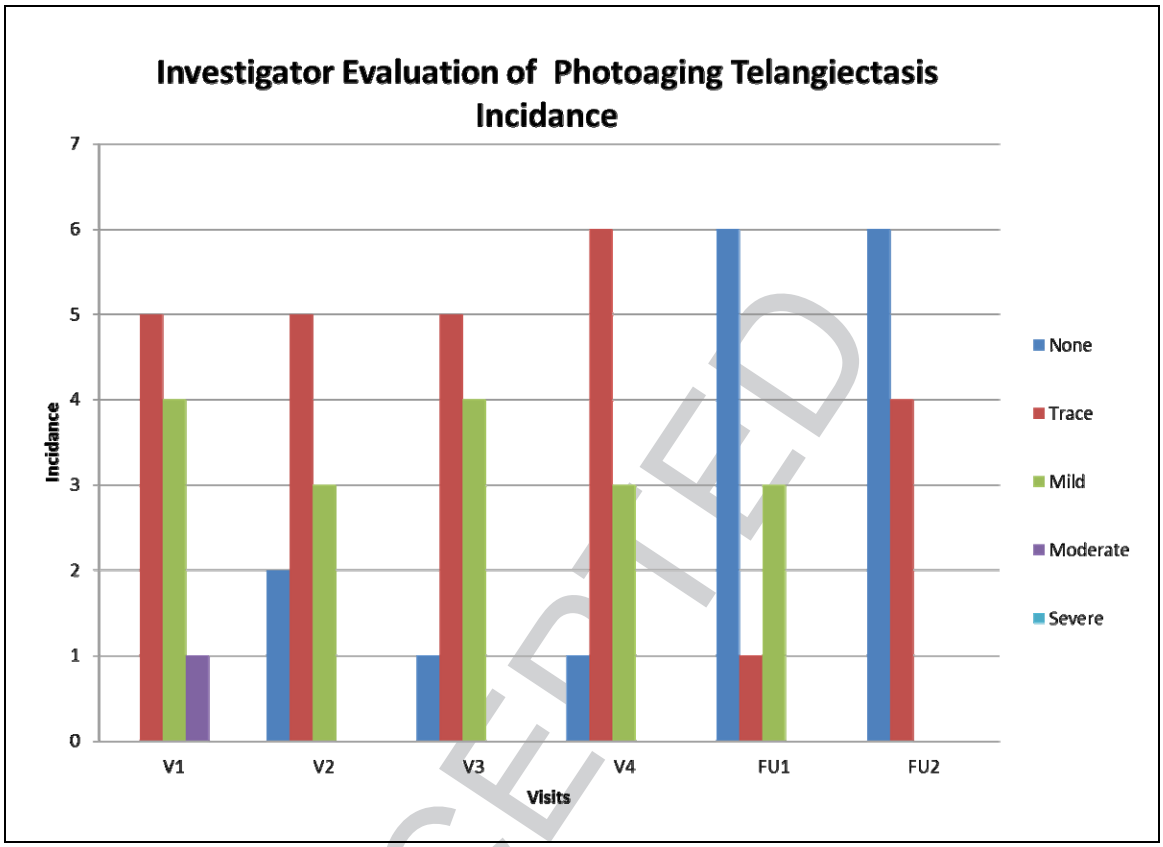

Figure 5

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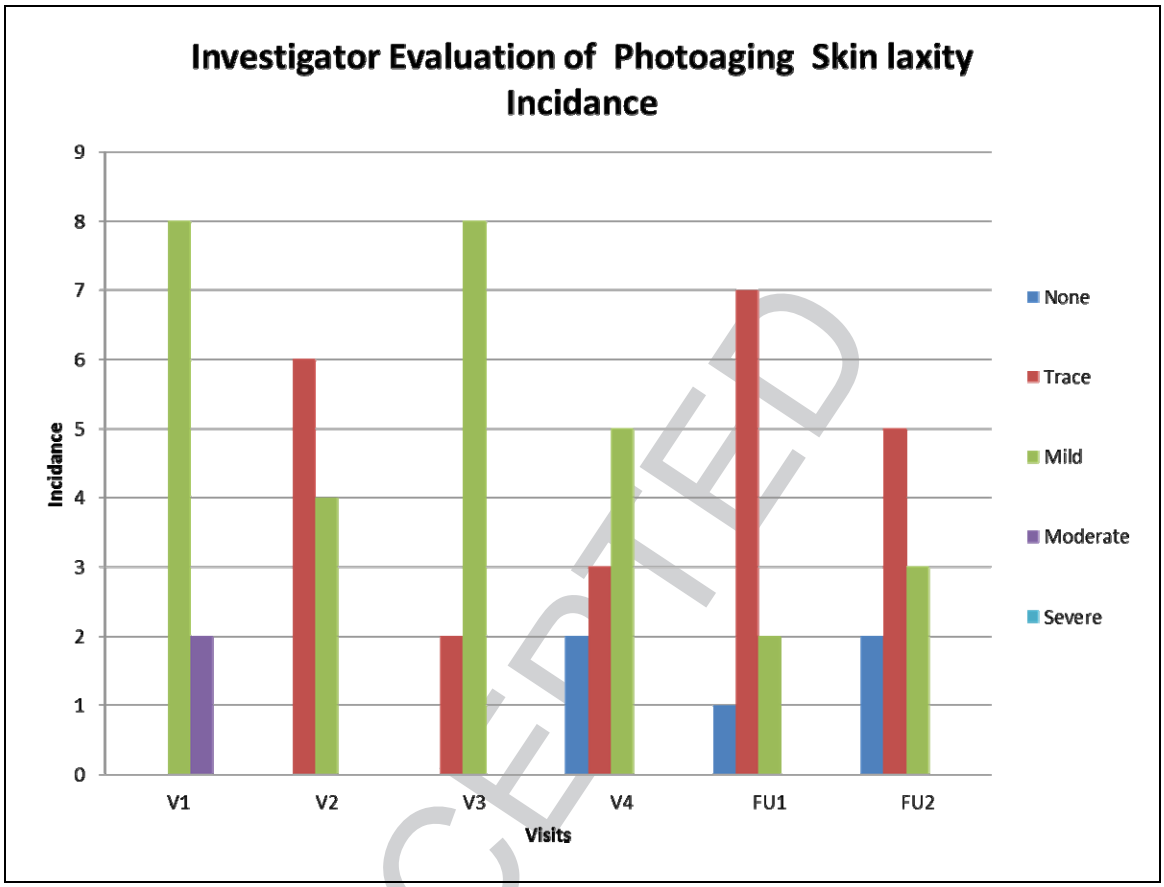

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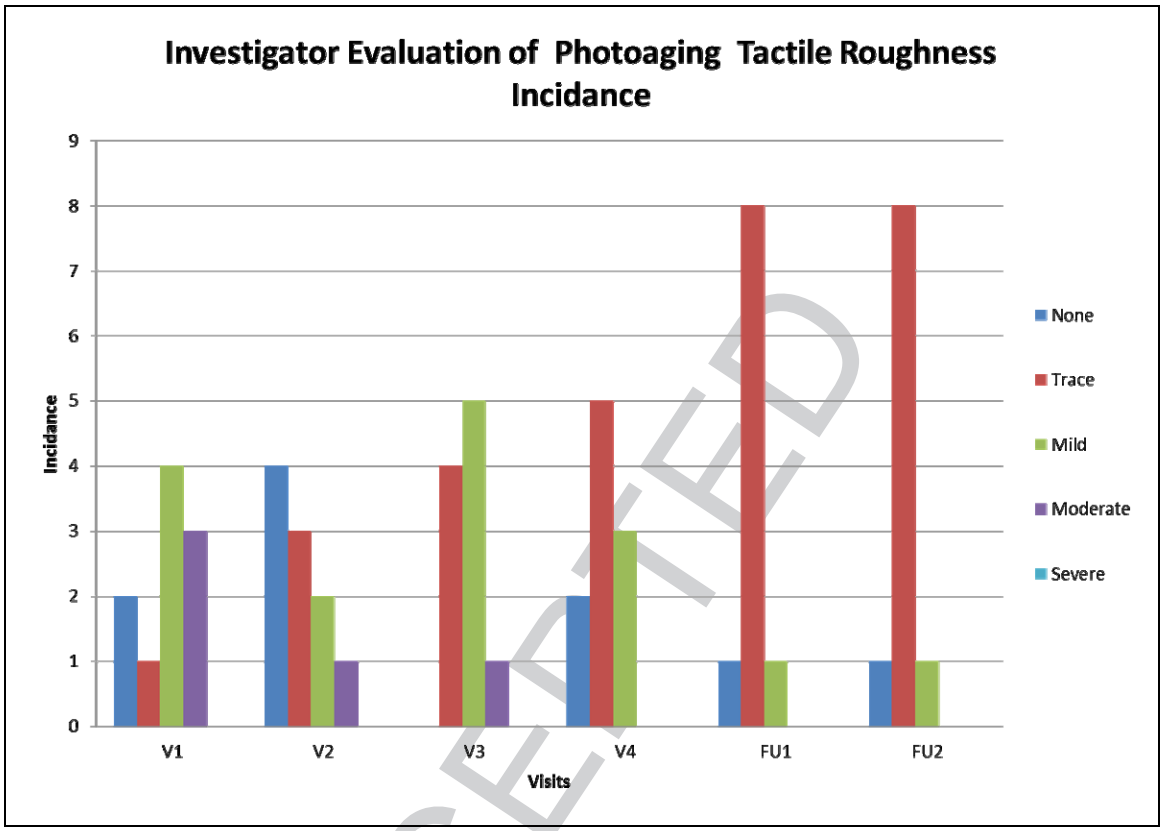

Figure 7

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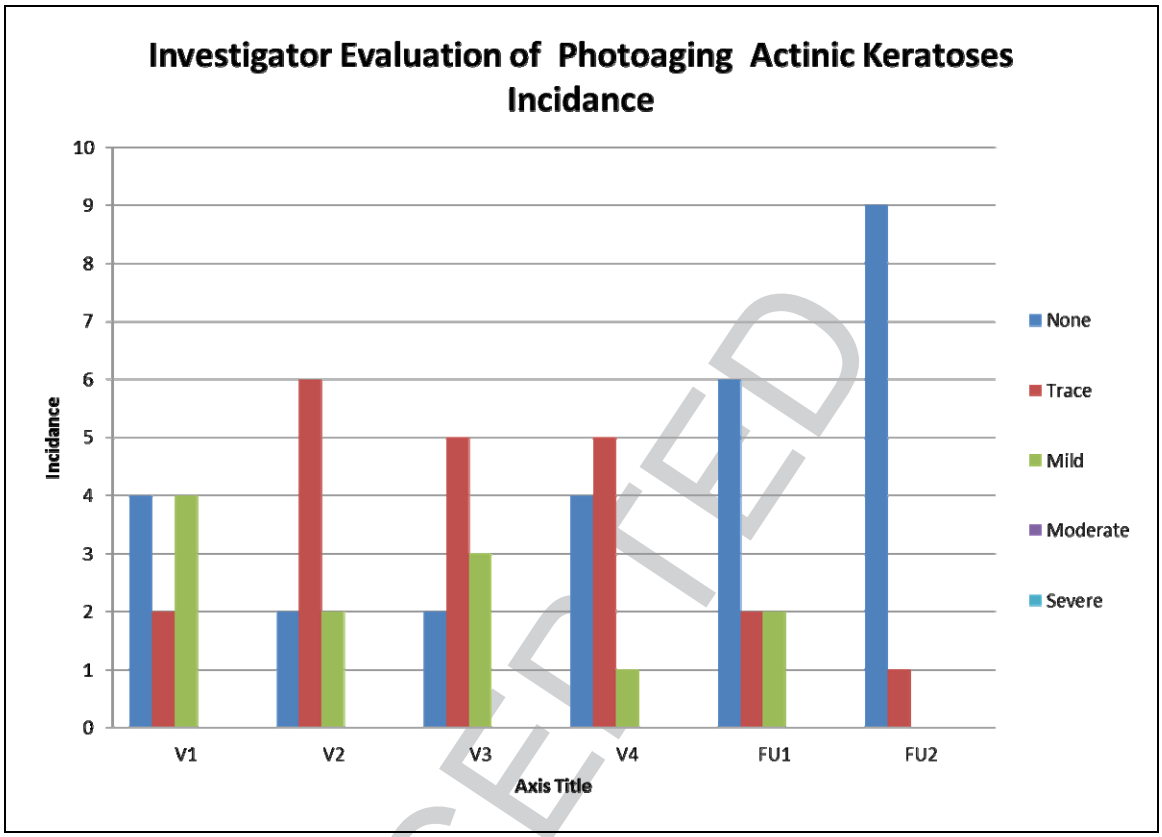

Figure 8

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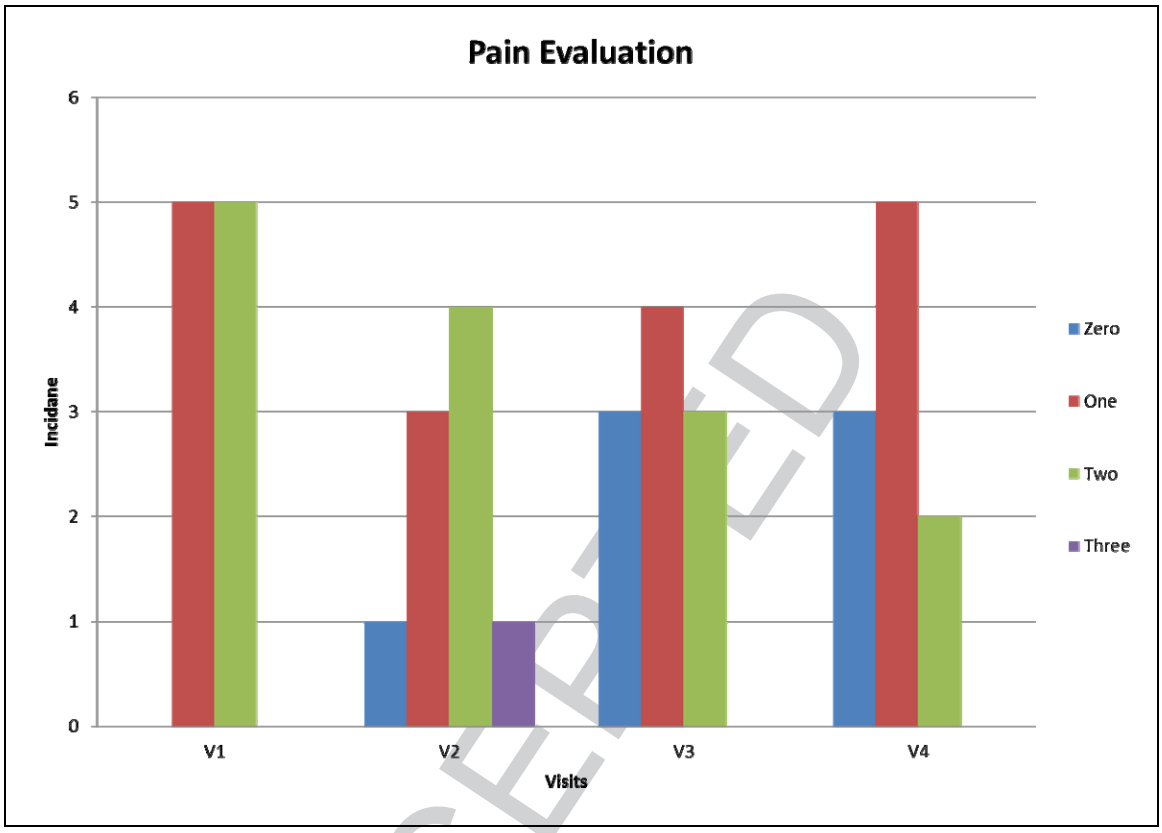

Figure 9

Before and After Clinical Picture
46 y/o female, Fitzpatrick skin type III
Baseline and 3 month f/u photos below
Glogau III at baseline, II at 3 month f/u
4 treatments:
1200kj/P
4Hz
5 passes