Picosecond Laser With Specialized Optic for Facial Rejuvenation Using a Compressed Treatment Interval

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Studies using a 755 nm picosecond laser with a focus lens array have been reported to be effective for facial wrinkles and pigmentation. This study reports the safety and efficacy using a shorter interval of 2–3 weeks between treatments. Nineteen female subjects and one male subject, primarily Fitzpatrick skin types II and III (one skin type I), who had mild to moderate wrinkles and sun-induced pigmentation were enrolled and treated using the 755 nm PicoSure Laser with focus lens array. The skin was cleansed then wiped with an alcohol wipe prior to treatment. Lidocaine 30% ointment and/or forced air cooling could be used to increase subject comfort. Adjacent pulses, with minimal overlap (10% or less), were delivered to the full face. Subjects received four treatments, performed at 2–3 week intervals. The laser energy used was 0.71 J/cm^2. The physician administered 3–7 passes with an average total of 6,253 pulses per treatment. Follow-up visits occurred at 1 and 3 months post-last treatment at which the physician scored satisfaction and improvement and subjects scored satisfaction and likelihood to recommend to others. The most common side effects were mild swelling, pain, redness, and crusting, most of which subsided within hours of the treatment, with the latest resolving within 48 hours. This is similar to a previous reported study (Weiss et al. ASLMS 2015) where treatments were performed every 6 weeks with side effects resolving within 24 hours. At the 1 and 3 month follow-up visits, 94% ($n = 19$) and 93% ($n = 15$) of subjects scored themselves as satisfied or extremely satisfied with their overall results and 81% and 93% were likely to recommend the treatment based on global assessment, respectively. The treating physician was satisfied with 93% of subject's overall results. Three blinded evaluators were able to correctly identify the baseline from post-treatment photographs in 77% of the subjects at the 1 month follow-up and 69% of the subjects at the 3 month follow-up, on average. The average treatment pain score was 4.2 on a 1–10 scale. A compressed treatment interval expedites results without increasing side effects and resulted in a high physician and subject satisfaction rate. Lasers Surg. Med. 48:723–726, 2016. © 2016 Wiley Periodicals, Inc.

Key words: picosecond; focus array; facial rejeuvenation

INTRODUCTION

The first picosecond 755 nm alexandrite laser (PicoSure, Cynosure; Westford, MA) was approved by the US FDA in 2012 after its success for tattoo removal requiring less treatments than traditional nanosecond quality switched (Q-switched) lasers [1]. This picosecond laser has an ultra-short pulse duration of 550–750 picoseconds and is currently FDA approved for the treatment of wrinkles, acne scarring, and removal of tattoos and pigmented lesions. The diffractive lens array is an additional specialized optical hand piece that attaches to the fixed 755 nm handpiece. It delivers and redistributes energy allowing multiple passes to be used to treat an area safely. It is a diffractive lens that redistributes energy and uniquely activates cell signaling and the dermal healing response. It has been used to treat rhytides, benign epidermal and dermal pigmented lesions, and acne scarring.

Lasers have a specific wavelength which are absorbed by a target and are able to treat pigmented melanocytic lesions by destroying the increased pigmentation without damaging the surrounding normal tissue. Benign pigmented melanocytic lesions are common and arise from sun exposure, aging, or congenital factors. These lesions either lighten or are removed when the laser energy passes into the skin, but is absorbed by increased amounts of melanin. Melanosomes have an approximate thermal relaxation time of 10–100 nanoseconds. Currently available Q-switched lasers have pulse durations in the nanosecond range, which has the potential to heat surrounding, unaffected skin leading to greater potential adverse effects [1]. The rapid absorption of picosecond light energy damages melanin, reducing the amount, leaving the treated skin uniform in color and texture. Prior studies of the diffractive lens array for improving benign pigmented lesions of facial skin have recommended 6-week intervals between treatment sessions with the picosecond

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laser [2]. In this study, we demonstrate that a compressed, 2–3-week treatment interval is safe and effective.

METHODS

This single-center, prospective study, approved by the New England institutional review board, was performed from March 2015 to September 2015. The study enrolled female and male patients between 30 and 70 years who had both facial pigmentation and rhytides. Exclusion criteria included patients who were pregnant or breast-feeding, on photosensitizing medications or had a hypersensitivity to light, active or systemic infections, or recent isotretinoin use in the past 6 months. Patients with a history of gold therapy, history of keloid formation, history of squamous cell carcinoma, or melanoma were also excluded.

Standard photographs using two-dimensional imaging were taken at baseline, before each treatment, and 1 and 3 months after the last treatment. A total of four treatments were repeated at intervals of every 3 weeks (±1 week). The subjects returned for evaluation at 1 month (±1 month) and 3 months (±1 month) after the last treatment. Treatments were performed with the 755 nm picosecond alexandrite laser with diffractive lens array (Focus Optic, Picosure 755 nm laser, Cynosure; Westford, MA). Single treatments with 3–7 passes were performed with less than 10% overlap for a minimum of 5,000 pulses to the full face, with an energy of 0.71 J/cm^2, pulse duration of 750 picoseconds, 6 mm spot size, and a repetition rate of 10 Hz. Treatment parameters remained the same for all patients. Patients were offered anesthesia with either forced air cooling or a topical anesthetic (4% lidocaine). Protective eyewear was placed on the patient, and appropriate goggles were worn by the treating physician. After completing each treatment, the patient rated the pain on a 10-point scale (1 = no pain, 10 = worst pain). One and three months after the last treatment patient and physician satisfaction were obtained based on a 5-point scale.

RESULTS

Twenty patients enrolled in the study and their ages ranged from 45 to 70 years (mean, 56.7 years). Nineteen women (95%) and one man (5%) with Fitzpatrick skin types I–III were treated, with most of the patients (95%) having skin types II and III.

Sixteen of twenty (80%) patients completed the study. Four patients completed the treatments but were lost to follow-up. The photographs taken at each visit were evaluated by three physician evaluators, who were not involved in the treatment, to identify pre-treatment images when compared to post-treatment images based on the global aesthetic improvement scale (GAIS). At 1 month follow-up, evaluators correctly identified baseline from post-treatment Photo 77%, and 69% at the 3 month follow-up.

The procedure was tolerated well with minimal down-time. The mean pain score of 4.2 (2.2) based on a 10-point pain scale (1 = no pain, 10 = worst pain). The most common side effects were redness (25%), pain (15%), and swelling (10%). There was no bruising, itching, scarring, hypo or hyperpigmentation, or infection. Patient and physician satisfaction was high. At the 1 month follow-up visit, 14 (93%) were satisfied or extremely satisfied with the overall results (Fig. 1). At 3 months, 13 (81%) were satisfied or extremely satisfied with the overall results and 13 (81%) patients would recommend the treatment (Fig. 2). The treating physician was satisfied with 93% of the subject's overall results at 3 months.

DISCUSSION

The results of this study show that this picosecond 755 nm alexandrite laser with a specialized diffractive lens is safe and effective for improving facial rhytides and pigmentation using a compressed interval between treatments. The new generation of picosecond laser delivery have efficient delivery of energy and lower thermal diffusion to surrounding tissues making them better suited to treat pigmented lesions compared to prior Q-switched lasers.

Brauer et al. used the 755 nm picosecond laser with diffractive lens array to treat facial acne scarring [6]. Their parameters were a 6 mm spot size, fluence of 0.71 J/cm^2, repetition rate of 5 Hz, and pulse width of 750 picoseconds with the diffractive lens array, allowing for greater surface area and pattern density per pulse. Patients received six treatments every 4–8 weeks. The treatments were tolerated well and the masked assessment of 17 patients were 1.5 of 3 and 1.4 of 3 at 1 and 3 months, respectively (a score of 0 indicates 0–25% improvement and a score of 3 indicates >75% improvement). The improvement in scar texture and volume was maintained 3 months after treatment, as proven by histologic analysis.

Weiss et al. found improvement in facial wrinkles and photoaging with the 755 nm picosecond diffractive lens array [2]. Twenty patients received four full face treatments every 6 weeks. There was an improvement in the Fitzpatrick Wrinkle Scale (1–9) at 6 months, with an overall average improvement of 2.7. Ninety-four percent of patients were satisfied at the 6 month follow-up. It is thought that the picosecond 755 nm alexandrite laser provides improvement in acne scarring and photodamage via intra-epidermal cavities that represent a region of laser induced optical breakdown (LIOB). Tanghetti demonstrated that the amount and density of these cavities depends on the melanin index and delivered energy when evaluated with histopathology [3]. The production of this LIOB can directly stimulate an epidermal repair mechanism that results in improvement of dyspigmentation and formation of new collagen and elastin.

The picosecond alexandrite laser has proven to be effective in areas aside from the face, such as the hands and decolletage. Saluja et al. used the diffractive lens on a 6 mm handpiece to treat photodamage on the hands and décolletage for a total of four treatments at 3-week intervals with follow-up at 1 and 3 months [4]. All hands and chest subjects showed significant

Fig. 1. Fifty-six year old female, baseline (left); 1 month post four treatments (right).

improvement in pigment dyschromia, textural irregularities, and rhytides.

The diffractive lens array is a specialized diffractive lens that alters the distribution of energy delivered to a treatment area. This optical handpiece is composed of approximately 120–130 diffractive lenses that evenly distribute energy in high-energy pulses affecting 5–10% of the total treatment area. These areas receive 20 times the energy compared to the background treatment area that receives low-level heat [5]. By minimizing unnecessary tissue damage, there is improved recovery time allowing a shorter interval between treatments when reducing facial photodamage. Tanghetti et al. studied histologic changes of skin treated with the 755 nm picosecond with fractional optic and described unique intra-epidermal cavities [6]. These cavities resulted from an area of laser induced optical breakdown (LIOB), which are enclosed intra-epidermal areas of damage. The number and size of cavities depends on the melanin index (amount of melanin in the epidermis) and

Fig. 2. Fifty-nine year old female, baseline (left); 1 month post four treatments (right).

the laser energy used. It is theorized that the injury is from localized plasma formation in the epidermis caused by the absorption of laser energy by melanin. These zones of injury form mends zones which exfoliate over the following 2–4 weeks. LIOB production can stimulate an epidermal repair mechanism that results in new collagen, elastin, and mucin formation. These phenomena could explain the improvement seen in acne scarring and dyspigmentation when using this specialized fractional optic [7].

Because picosecond lasers have pulse durations that are approximately 100 times shorter than the commonly used QS lasers and are closer to the thermal relaxation time of melanosomes. This allows for more power to be delivered at a lower fluence, allowing for more effective treatments with fewer adverse reactions [7]. Very few adverse events have been reported with picosecond lasers. This study supports the favorable safety profile of the picosecond laser and was well tolerated by all study participants. However, future large-scale studies on the use of these picosecond lasers will have to be done in order to establish optimal treatment parameters for various indications. A shortened treatment interval of 2–3 weeks expedites results without increasing side effects when using the 755 nm picosecond laser diffractive lens to treat facial pigmentation and wrinkles.

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