Safe and effective Skin Rejuvenation and Pigment Removal performed with Pico Toning by a novel 1064 / 532 nm Picosecond Laser

PETER MUZIKANTS

Keywords:
Laser, Rejuvenation, Picosecond, Pico Toning, LIOB

Summary:
This article shows a novel, minimally invasive laser method for skin rejuvenation by creating isolated microscopic lesions within tissue below the epidermis using laser induced optical breakdown (LIOB). Using a well-researched technology, wavelengths of 1064/532 nm focused near-infrared laser pulses are used to create optical breakdown in the dermis while leaving the epidermis unharmed, resulting in cavities due to plasma formation. This stimulates a wound healing response and leads to stimulation and neocollagenesis terminating in results of skin rejuvenation such as improvement of laxity, colour, and improvement in the appearance of pores. A retrospective trial with analysis of in-vivo, non-interventional treated human skin samples successfully showed the safety and effectiveness of the treatment; microscopic in LIOB and macroscopic in edema and erythema. Treatments can be performed by minimal to no downtime and mild to no side-effects with no topical anesthetics needed. The non-interventional in-vivo results shown by confocal laser microscopy (LC-OCT), showed evidence of microscopic cavities and new collagen formation around the vacuoles.
Conclusion: This method is a safe and efficient alternative to more invasive procedures by minimal to no social downtime and mild to no side effects.

INTRODUCTION / PURPOSE

Over two decades of years invasive methods such as surgically performed face lifts, thermal laser ablation (Skin Resurfacing), fractionated skin treatments with weeks of social downtime and partly high risk of severe side effects [2], such as painful performed radiofrequency procedures, due to excessive heat [1], have dominated the aesthetic market as a golden standard [2] and helped many patients to improve the appearance of their skin in terms of tightness and flawlessness.

While procedures performed by lasers working through photo thermolysis (non-ablative and ablative) are creating thermal damage to the skin, this method can be identified as a cold performed treatment, which leaves the epidermis of treated skin virtually unaffected.

METHODS/MATERIALS

To evaluate the safety and effectiveness of laser induced optical breakdown (LIOB) for skin rejuvenation, treatments were performed on facial skin of a female of 40 years, with moderate sun damage, Fitzpatrick skin type 2.

The laser used was 1064 nm wavelength, max pulse energy 800 mJ, 300 picosecond laser from Asclepion (Asclepion Laser Technologies, Jena Germany). The Microspot fractional handpiece for 1064 nm was used. This was performed by a diffractive optical element to generate 64, 300-micron beamlets in a 7 x 7 mm square area.

Treatment protocol included 4 treatments over an 8-week period. First 3 treaments at 2 weeks interval and the 4th treatment after 4 weeks. The whole area of the face was treated. Prior to laser treatment the skin was cleansed with chlorhexidine, no anaesthesia was used or required as the level of patient discomfort was trivial. Settings used for each treatment were: fluence 0.3-0.4 J/cm^2, 3-5 Hz and 3-4 passes. During the laser treatment particular attention was paid to maintain the correct handpiece spacer distance with skin to ensure LIOB placement was in the deep dermis, to minimize petechial haemorrhaging and the loud photoacoustic cracking sound which signified too superficial dermal/epidermal LIOB placement. Small areas of deeper actinic keratosis were spot treated with a higher number of passes, using the same fluence.

After treatment, a light occlusive hydrating gel was applied. At home, light moisturizer cream was recommended and applied at least twice a day with daily sun protection of 50 SPF.

MECHANISM OF ACTION

Skin regeneration using this fractional 300 picosecond handpiece is the result of the acoustic shock wave and microcavity formation at the optical focal point within the dermis demonstrated in confocal laser microscopy

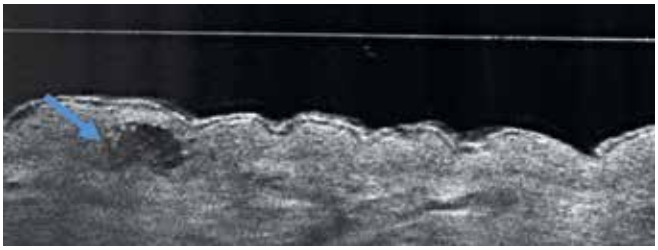

Fig. 1 [4]: LC-OCT vertical, 5 mm LIOB 130 µm*104 µm. Dimension 1,2 mm * 0,5 mm.

imaging fig. 1 [4]. The microcavity formed LIOB; called laser induced optical breakdown, is not deduced from selective photothermolysis. LIOB occurs at the optical focal point where laser energy threshold is reached to ionise tissue at that point creating a plasma formation and acoustic shock wave that can invoke cytokines and other cell messengers for dermal remodelling. Further, the plasma formation creates ablative tissue with thermal confinement leaving a microcavity that in addition induces cytokine messengers leading to more dermal remodelling see fig. 2. This is essentially a non-thermal mechanism to inducing dermal/epidermal skin remodelling.

RESULTS

The Initial three fractional 300 psec treatments were done at 3 weekly intervals, the final fourth treatment was 4 weeks later. No anaesthesia was required as the patient reported minimal pain/discomfort. Immediate skin reaction was moderate erythema and some fine pinpoint petechia. There was minimal facial swelling, which settled after a couple of days. The actinic keratosis spots treated with higher number of passes showed mild petechial haemorrhaging. Fig. 3 shows the immediate skin reaction with minimal edema and moderate erythema.

Recovery time was 5 days for redness and mild swelling to settle. No adverse symptoms or reactions reported, and the patient returned to work after 2 days and some make up could be applied.

Results 12 weeks after the 4 fractional Microspot laser treatments showed significant improvement in facial skin quality and texture. There was removal and or reduction of actinic keratoses. Specifically, improvement in the skin luminosity, pigmentation and texture was noted. Further, reduction in lines and creases especially lower eyelid area, periorally and forehead was also noted see fig. 4 a+b.

PATIENT SATISFACTION

The patient was very satisfied with the treatment. She did not rate the treatment as being painful and did not require any topical anaesthesia or nerve block injections. Afterwards, the recovery was quick because of a lack of significant facial swelling, exudation, crusting or

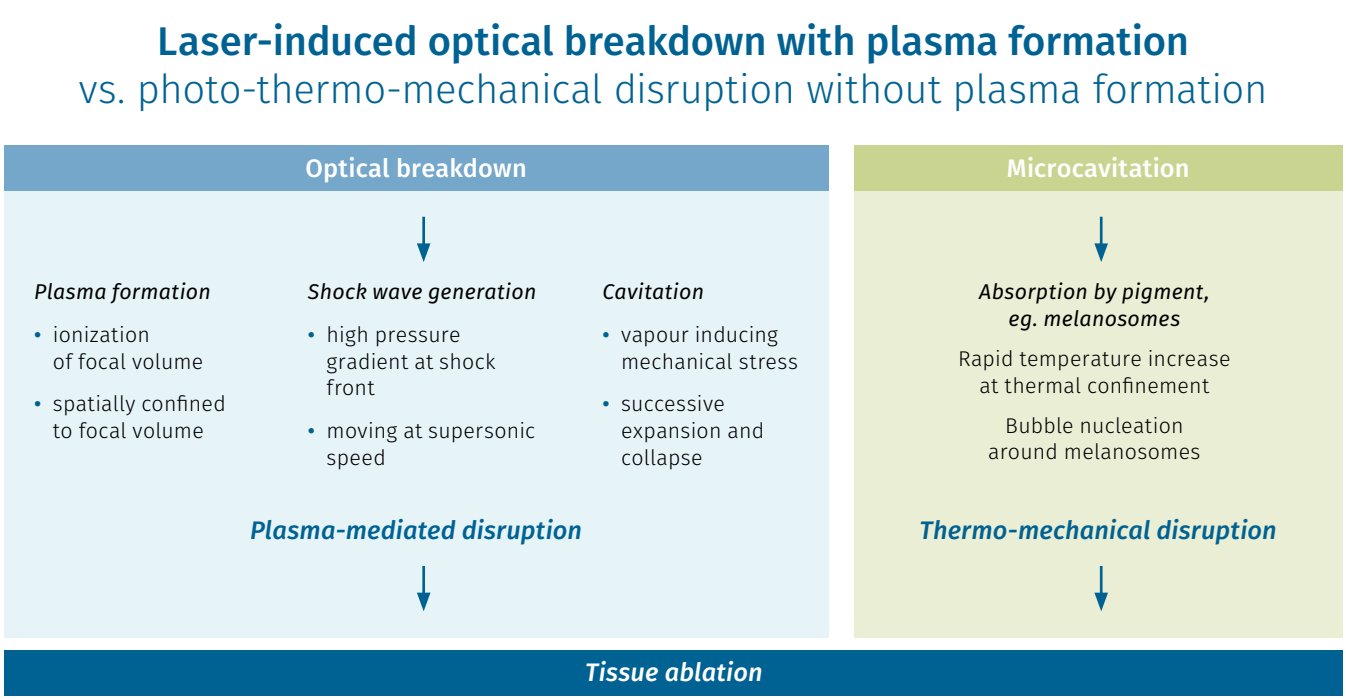

Fig. 2 [3]: Rockwell BA, Thomas RJ , Vogel A. Laser-Tissue Interactions.
Med Las Appl 2010 25:84-92, Springer Verlag Heidelberg 1996 p. 105

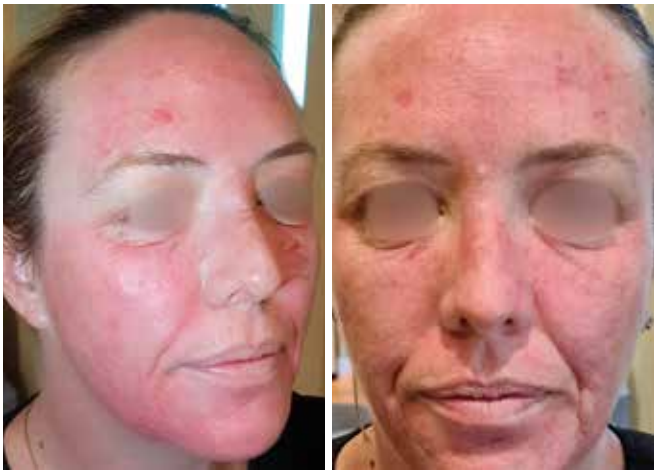

Fig. 3a+b: Immediately after laser.

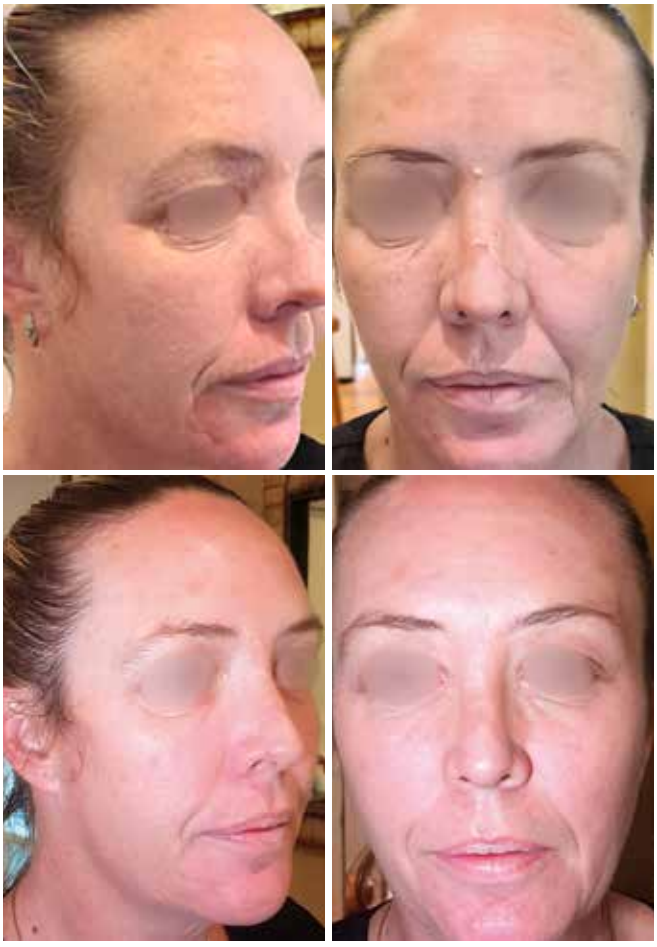

Fig. 4a-d [7]: Before and after 4 fractional picolaser treatments.

discomfort. The redness could be covered with make-up, if necessary but it cleared quickly, and she returned to work after 2 days.

She was very satisfied with the result and would consider further treatment to gain additional improvements.

DISCUSSION

This case demonstrates that the laser treatment using 300 picosecond 1064 nm producing LIOB can induce significant dermal and epidermal skin remodelling [8] for skin rejuvenation of chronologic and photoaged skin. This was done without the thermal side effects of pain, significant swelling, and prolonged recovery time that selective photothermolysis lasers like ablative carbon dioxide, erbium, and non-ablative lasers. Because of a lack of thermal side effects, treatments can be repeated at shorter intervals and patients are more likely to complete the course of treatments prescribed.

Pico fractional laser would also be considered a safer alternative for skin more prone to thermal side effects of post inflammatory pigmentation in the darker skin types. Zhou et al also recommended to use a DOE laser (laser with a diffractive optical element instead of a micro lens array) to avoid side effects in sensitive or darker skin types.

The LIOB being generated at the optical focal point of the beamlets means, that the keeping the spacer distance from the hand piece to skin is critical to ensuring LIOB's are placed in the dermis, the most biologically active area. Moving the hand piece off the skin means that LIOB position will be moved more superficially causing loud acoustic cracking sound as ionization9 of epidermis air interface occurs. This phenomenon is also described by Kim et al in ex vivo porcine skin9 This will cause break in epidermal layers leading to petechial bleeding of the skin, a longer recovery time with no added benefit to the results as the LIOB is in lesser immunological active zone.

The fractional Pico laser treatment being essentially a non-thermal treatment this can be combined with other thermal energy-based treatments such as fractional ablative and non-ablative lasers, other non-ablative laser photo rejuvenation, RF devices and thermomechanical devices treating upper dermis. Combining thermal and non-thermal treatments can allow more complete treatments to gain better skin rejuvenation.

CONCLUSION

Laser using 1064 nm wavelength, 300 picosecond pulse duration can be used as a fractional laser, that generates non-thermal acoustic energy (LIOB), which can induce dermal skin remodelling. This results in the advantage of reduced thermal side effects as pain, swelling, prolonged recovery time, as well as potential thermal side

effect of scarring, hypo- and hyperpigmentation. This fractional Pico laser can be used for skin rejuvenation to profoundly improve skin quality, colour, and texture especially for sensitive, predestined skin to minimize thermal side effects.

Compliance with ethical guidelines

Conflicts of interest for the study: The author declares that he has no competing interests. Peter Muzikants recurringly holds lectures for Asclepion Laser Technologies, the company distributing the PicoStar device. This device has been regularly purchased by the clinic. His research did not involve animals.
Informed consent was obtained.
The PI commits himself to comply with the local regulations applicable to clinical studies.

Address of Correspondence:

Dr. Peter Muzikants, M.D.
Laser & Aesthetic physician,
Áda Aesthetic Medicine, Sydney
88 Glebe Point Road
Glebe NSW 2037
Sydney, Australia
muzikants@optusnet.com.au

References:

1. Burns JA. Thermage: Monopolar Radiofrequency. Aesth Surg, 2005; 25(6): 638–642. doi.org/10.1016/j.asj.2005.09.017
2. Bernstein LJ, Kauvar AN, Grossmann MC, Geronemus RG. The short- and long-term side effects of carbon dioxide laser resurfacing. Dermatol. Surg. 1997; 23(7): 519–525. DOI: 10.1111/j.1524-4725.1997.tb00677
3. Laser-Tissue Interactions: Fundamentals and Applications, Markolf H. Niemz, January 2019. DOI:10.1007/978-3-030-11917-1
4. Courtesy of Asclepion Laser Technologies,
Prof. Julia Weizel, M.D., Dermatological Department of University Clinic, Augsburg 2021
5. Courtesy of Dr. Peter Muzikants
6. Habbema L, Verhagen R, Van Hal R, Liu Y, Varghese B. Minimally invasive non-thermal laser technology using laser-induced optical breakdown for skin rejuvenation. J Biophotonics. 2012; 5(2):194-9. doi: 10.1002/jbio.201100083
7. Kim H, Hwang JK, Jung M, Choi J, Kang HW. Laser-induced optical breakdown effects of micro-lens arrays and diffractive optical elements on ex vivo porcine skin after 1064 nm picosecond laser irradiation. Biomed Opt Express. 2020; 11(12): 7286-7298. doi: 10.1364/BOE.410991
8. Zhou Y, Hamblin MR, Wen X. An update on fractional picosecond laser treatment: histology and clinical applications. Lasers Med Sci. 2023; 38(1): 45.3