ISSN 1855-9913

Journal of the Laser and Health Academy
Vol. 2015, No.1; www.laserandhealth.com

CASE REPORT: Combined Er:YAG and Nd:YAG Laser Treatment for Non-invasive Body Contouring

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ABSTRACT

Although laser lipolysis has been described as a "lunchtime treatment", it is nevertheless classified as a surgical procedure associated with certain risks due to surgical incisions and the use of anesthetics, as well as with subsequently reduced skin firmness and lack of skin ability to conform to the reduced body size. We aimed to develop a safe and effective alternative to address both excess body fat as well as surface appearance of the skin on the selected body areas. The method is based on the application of a combination of 2940 nm Er:YAG thermal pulse for controlled surface tissue heating with subsequent collagen remodeling and 1064 nm Nd:YAG super-long pulse for deep bulk heating of the skin with the purpose of both reducing adiposity and shaping the body by heating shrinkable connective structures. This method, which was later developed into the TightSculpting™ procedure, has proven to be a non-invasive, safe and comfortable body-sculpting solution with long-lasting effects.

Key words: body contouring, Er:YAG, Nd:YAG, non-invasive fat reduction, skin tightening.

Article: J. LA&HA, Vol. 2015, pp.48-50.
Received: June 1, 2015; Accepted: October 9, 2015

I. INTRODUCTION

Non-invasive body contouring is one of the fastest growing market segments in aesthetic medicine. Laser-assisted lipolysis is a popular, minimally invasive surgical procedure that is considered safer and results in shorter downtime compared to traditional liposuction. Despite these benefits, it is still considered as a surgical procedure as it is associated with surgical incisions and the use of anesthetics, and adverse effects are still possible [1]. Furthermore, many patients are not ready for and will never consider any surgical procedure, no matter how "minimally invasive" it is. Consequently, non-invasive "cellulite treatment" procedures and devices have been used for many years, from topical agents, oral, massage, carbon dioxide, compressive and shock-wave therapy to energy devices which involve ultrasound (US), cryolipolysis, radio frequency (RF), infrared (IR) radiation, diode and laser therapy, with significant heterogeneity in effect between different treatments [2-3]. Non-invasive thermolipolysis is one of the procedures that induce either adipocyte necrosis or apoptosis or stimulate normal lipolysis metabolism with the breakdown of triglycerides to glycerol and free fatty acids, which are metabolized through normal hepatic pathways [4-7]. It has been previously demonstrated that damage to adipocytes during exposure to heat is exponential and dependent on the temperature and length of exposure. Heat can induce delayed vascular alterations and reduce adipocyte viability to 40% with 3 minutes of cellular exposure to 45°C [5].

Our focus was mainly on Er:YAG and Nd:YAG lasers, which have previously been used successfully for mucosa tissue and skin tightening. The 2940 nm Er:YAG laser in the non-ablative regime acts to deliver energy onto the skin to produce controlled surface-tissue heating without ablation, as well as subsequent collagen remodeling, with the purpose of improving skin or mucosa thickness, elasticity and firmness [8-12]. For the purpose of deep bulk heating of the skin, 1064 nm Nd:YAG can be used in a super-long PIANO® pulse modality. This seconds-long pulse regime enables sufficient time for the epidermis to share the absorbed heat with the dermis through heat diffusion, thus sparing the epidermis from potential injury [13-14].

Our aim was to test the safety and efficiency of this combination treatment method for non-invasive body contouring. Superficial tightening of the skin was performed using a 2940 nm Er:YAG SMOOTH thermal pulse, combined with deep bulk heating of the skin to temperatures above 40 °C, using a seconds-long 1064 nm Nd:YAG PIANO® pulse. The idea was to simulate the same effects achieved during laser lipolysis and generate an increase in tissue temperature to above 40 °C.

II. CASES

Patients have come to our clinic for the purpose of skin tightening and fat reduction on smaller areas of the body, such as the abdomen, back, thighs, arms and

chin. Contraindications to treatment were pregnancy, epilepsy, uncontrolled hypertension, cardiac arrhythmias or heart disease, pacemakers, recent or current history of cancer or actively undergoing chemotherapy treatment, liver/kidney disease, photosensitivity and immunosuppressive disorders.

Local anesthetic cream was applied to the treatment areas for 30 min and removed before the treatment. Areas for the treatment were clearly marked and divided into smaller areas if needed. Laser application lasted about 15-30-min per each body area and consisted of 2 consecutive steps, performed on each of the pre-marked smaller areas in the following sequence:

a) Superficial skin tightening with thermal Er:YAG pulse

2940 nm Er:YAG laser (SP Dynamis, Fotona) was used in LP/VLP/XLP regime (pulse duration), using an R04 handpiece (12 mm spot size), fluence of 1.1-1.3 J/cm2 and frequency of 10 Hz. Our technique involved using both hands; the guiding hand to stabilize the skin to ensure we reach all the structures and the working hand to deliver the laser treatment. Due to the irregular heat penetration, multiple passes should be performed across each of the pre-marked smaller areas, simulating brushing (continuous) movement, much like with a laser lipolysis cannula.

b) Tightening of deep skin structures and reduction of adipose tissue with super-long Nd:YAG pulse

1064 nm Nd:YAG laser was used (SP Dynamis, Fotona) in a super-long pulse regime of 18 – 21 sec (PIANO® pulse) with an R34 handpiece (20 mm spot size) and fluence of 400 J/cm2. The same technique was used as in the above described second step, performing multiple passes across the same area in a continuous motion (Figure 1).

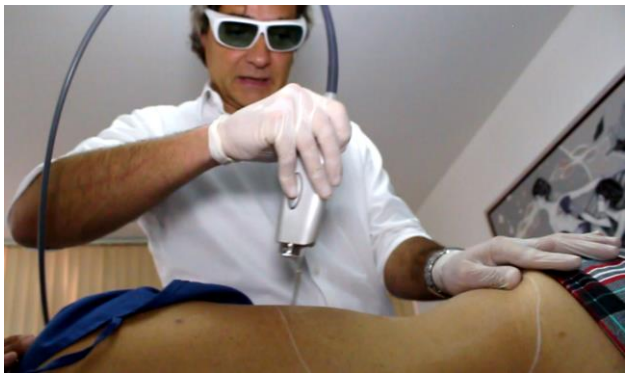

Fig. 1: Tightening of deep skin structures with super-long Nd:YAG PIANO® pulse. Multiple passes across the same area are performed in a continuous motion.

The whole procedure is performed on each of the separate body units (abdomen, waist, etc.) before moving to the next. Up to as many as 8 sessions can be performed, with a minimum of a 10 day interval.

III. RESULTS AND DISCUSSION

During a combined Er:YAG and Nd:YAG laser treatment using thermal pulses, superficial tightening is combined with deep heating of the skin. During the treatment, the generated heat is transmitted through the skin, increasing local vascularization and accelerating organic chemical reactions, including fat metabolism, as well as causing the tightening of deep connective structures (reticular dermis, retinaculum cutis, fasciae). Moreover, superficial tightening using thermal Er:YAG pulses works to improve flaccidity and the surface appearance of the area. With our combined procedure, we were able to achieve immediate and lasting effects (Fig. 2-5). In our experience, an average of 7-8 cm in waist circumference reduction can be achieved. Moreover, ultrasound evaluation showed significant reduction already after 1 session (Fig. 6). However, results varied between patients, with more effects in some and less in others.

Fig. 2: Combined Er:YAG and Nd:YAG laser treatment of the waist region. Before (left) and immediately after 1 session (right).

Fig. 3: Combined Er:YAG and Nd:YAG laser treatment of the waist region. Before (left) and 3 months after 2 sessions (right).

Fig. 4: Combined Er:YAG and Nd:YAG laser treatment of the abdominal region on a patient with a history of laser lipolysis. A successful destruction of fibrotic tissue areas as well as improved skin flaccidity are seen immediately after 1 session (right).

Fig. 5: Combined Er:YAG and Nd:YAG laser treatment of the thigh area. Before (left) and after 8 sessions (right).

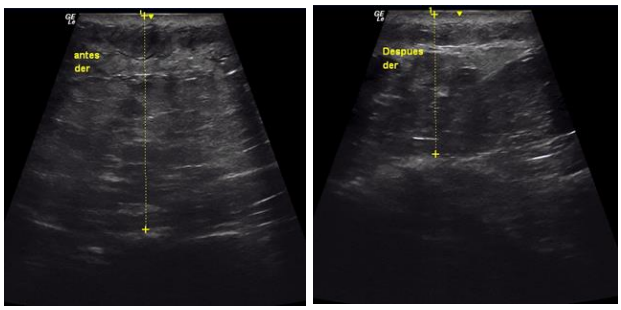

Fig. 6: Ultrasound evaluation of tissue before (left) and after (right) single session with combined Er:YAG and Nd:YAG laser treatment shows significant reduction

Transient erythema was observed immediately after the treatment in all cases, but was resolved within a few hours to a few days. The treatment is comfortable and needs no special after care, and the patient can return to daily activities immediately afterward.

There are a few recommendations to further improve the effect of the treatment. In some cases, the application of laser light over localized adiposity may additionally be performed to enhance the result. The area is marked with dots, approximately 5 cm apart. Approximately three laser pulses are delivered in each of the localized sites (dots) with 1064 nm Nd:YAG in a super-long pulse regime of 1.1 s (PIANO® pulse) with an R33 handpiece (4 mm spot) and fluence of 55-65 J/cm2. The effects may be further improved with a 20 minute light cardio workout (on a stationary bicycle or treadmill) immediately after each session, followed by lymphatic drainage, which may help to immediately metabolize the fatty acids released as an energy source during the laser treatment. If possible, a compression garment is recommended to be used 12 h per day for the first month after the treatment and 6 h per day the following month. In our case, ideal patient for the treatment had a BMI between 25 and 30. Routine or effective diet and physical exercise may help to maintain the effect of the treatment, but for areas of lipodystrophy with poor vascularization of the adipose areas, this method represents a safe and effective alternative to laser lipolysis.

IV. CONCLUSION

Combined Er:YAG and Nd:YAG laser treatment for body contouring has proven to be a comfortable, safe and effective treatment for trans-dermal skin tightening and reduction of adipose tissue. In combination with a healthy lifestyle, this method, which has later been developed into the TightSculpting™ body sculpting procedure [15], represents a very promising non-invasive alternative to laser lipolysis.

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