Laser Lipolysis with Sequential Emission of 1064 nm and 1320 nm Wavelengths

Barry E. DiBernardo, MD[1], Mitchel, P. Goldman MD[2], Raminder Saluja MD[2],
Katrina Woodhall MD[2], Jennifer Reyes, PA-C[1]

[1]New Jersey Plastic Surgery, Montclair, NJ
[2]Dermatology/Cosmetic Laser Associates of LaJolla, Inc, LaJolla, CA

Introduction

As more women and men want to look and feel better, body contouring and liposculpture continue to grow in popularity, making liposuction the most popular cosmetic surgery performed today (ASAPS 2006).

Apfelberg is credited for describing the laser-fat interaction[1] in 1992 and publications by Blugerman[2], Schavelzon[3] and Goldman[4] followed where each demonstrated their own experience with lasers on adipose tissue. Badin[5] also highlighted the important tissue retraction that he noted with his technique of laser lipolysis. Ichikawa published on the histological evaluation of tissue treated with laser lipolysis, showing the destructive changes of heat-coagulated collagen fibers and degenerated fat cell membranes with dispersion of lipid after laser irradiation of human specimens.[6] These histological changes correlate with clinical changes seen by both physician and patient. Further, the hemostatic properties of the 1064 nm wavelength have been well documented. The thermal effect produced by the Nd:YAG laser (1064 nm) in the adipose tissue promotes better hemostasis resulting in better wound healing, and less surgical trauma. In addition to the histological evidence, the clinical evaluation shows improved postoperative recovery, resulting in a more rapid return to daily activities with an excellent aesthetic result.[7]

Performance of liposuction now has the ability to target areas of flaccidity as well as excess adiposity. The Smartlipo™ laser provides a minimally invasive procedure for sculpting body contours with less downtime and side-effects. Laser-assisted liposuction can be used in several areas of the body and face, including the mandibular border, submental region, breasts, upper and lower abdomen, back, flanks, hips, pubic area, inner and outer thighs, buttocks, knees or ankles.

We evaluated a new generation system, Smartlipo with MultiPlex (known as Smartlipo™ MPX), which allows individual as well as sequential emission of 1064 nm and 1320 nm wavelengths. The sequential firing of these two wavelengths in combination maximizes the positive properties of both. The combination of these wavelengths increases the efficiency of fat lipolysis and offers a more evenly distributed laser energy profile which benefits superficial and deep treatment. These two wavelengths emitted sequentially offer a more efficient vascular coagulation through the conversion of hemoglobin to methemoglobin[8]. The 1320 nm wavelength heats the blood converting hemoglobin to methemoglobin. The 1064 nm wavelength has a 3-5 time greater affinity for methemoglobin than for hemoglobin thereby increasing absorption resulting in more efficient coagulation leading to skin tightening.

We further tested the SmartSense delivery system featuring an intelligent chip – the "Accelerometer" - which attaches to the laser handpiece providing feedback to the laser. Through the use of SmartSense, the laser is deployed only when the handpiece is in motion and adjusts the amount of energy delivered with the motion of the handpiece. The laser energy distribution is proportional to the rate of movement of the handpiece. As the surgeon slows the movement of the handpiece, the laser energy drops accordingly. If the laser handpiece comes to a complete stop, the laser will stop within 0.2 second. This method ensures optimal patient safety by preventing excessive thermal damage.

Methods

The clinical evaluation of the 1064 nm and 1320 nm sequentially firing laser device with SmartSense safety mechanism for lipolysis was conducted at two different clinical sites. The goal of this study was to evaluate the use and safety of this laser for eliminating of unwanted fat and skin tightening as a result of tissue coagulation and contraction, and to further evaluate the effectiveness of an accelerometer in preventing thermal damage to dermal and epidermal tissue. Patient selection, including the inclusion and exclusion criteria listed below was followed by both clinical sites. However, the treatment and tumescent tech-

niques varied as standard procedures are different for each treating physician.

The inclusion and exclusion criteria included:

Inclusion Criteria:

1. Subjects 18-70 years of age
2. Presenting for liposuction due to unwanted cosmetic fat combined with flaccid skin to any body area
3. Written consent to participate in the study

Exclusion Criteria:

1. Pregnancy or pregnancy within the last 3 months
2. Recent abdominal surgery or disorders of the lower abdomen (i.e. hernia, ulcerative colitis, Crohn's disease, spastic colon, etc.)
3. History of Thrombophlebitis
4. Acute infections
5. Heart failure
6. Intolerance to anesthesia
7. Previous liposuction to the study area
8. Any medical condition, that, in the investigator's opinion, would interfere with the subject's participation

A single laser treatment was administered using the Smartlipo MPX system. Smartlipo MPX affects adipocytes through thermal and photo-mechanical interactions. Specific to this procedure, the laser energy is delivered to the subcutaneous tissue through an optical fiber which is threaded through a cannula. A section of the optical fiber, 2 mm in length, protrudes through the distal end of the cannula.

Additionally, 5x5 cm squares were drawn with a surgical marker covering the entire area to be treated. At the first clinical site, laser dose was administered to the deep fat tissue using the MultiPlex mode. Subsequently, superficial lasing was performed by moving the laser fiber subdermal until the aiming beam was clearly visible dime size. At the second site superficial fat and dermis were treated simultaneously. Both clinical sites treated in a similar fashion in the deep dermal plane, but at the second site the cannula and fiber were then moved into the superficial plane and the lasing was continued. When lasing into the superficial plane, skin surface temperature was monitored and lasing was stopped when skin temperature reached 38-40 degrees Celsius.

Clinical Case Studies

The following cases demonstrate the results produced by laser lipolysis with Smartlipo MPX when applied to the anterior thighs, abdomen and neck involving three patients.

Patient 1

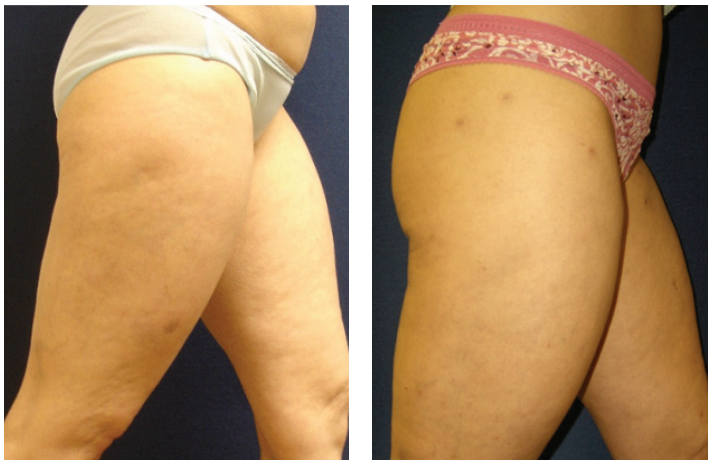
A 37 year old female with excess adipose tissue on her thighs, desired cosmetic enhancement. She was a non-smoker, who was on thyroid supplementation for the past 15 years and was otherwise healthy. She had no history of previous liposuction to the thighs.

Informed consent was obtained and baseline photographs were taken prior to the surgeon's marking. She was taken to the operating room where she was prepped and draped in standard sterile fashion. 3 mg of Versed and 25 mcg of Fentanyl were administered intravenously for mild sedation.

Warm tumescent anesthesia with dilute lidocaine, epinephrine and sodium bicarbonate was then administered to the subcutaneous layer until the area was fully tumesced (total of 4.15 liters administered).

Four 5 x 5 cm areas were drawn on each anterior thigh area and laser lipolysis was performed on each square with 15 Watts of 1064 nm and 10 Watts of 1320 nm wavelengths in MultiPlex mode. The energy was delivered until the tissue was pliable.

Figure 1



Before Tx (left) and after 1 week (right)

Laser lipolysis was then followed by traditional aspiration utilizing a 2.5 mm suction cannula with negative pressure around 350 to 450 mmHg. The patient tolerated the procedure well.

No significant lipid elevation was noted from baseline to immediately after laser exposure, 1 day, 3 days or 1 week post operatively. Baseline triglycerides levels were 88, 108 at 1 day, 106 at 3 days and 106 at 1 week post treatment.

At one month follow-up, the patient was pleased with her results and felt that the area exposed to the laser had a smoother texture when compared to the non exposed site. She would recommend this procedure to family and friends.

Patient 2

The second patient was a 52 year old female who desired laser lipolysis for her neck. She had no previous liposuction to her neck and her past medical and surgical history was insignificant.

Figure 2

Pre Tx (left) and 1 month post Tx (right)

The same pre-operative procedures were employed and she was taken to the operating room where 250 cc of warm tumescent fluid with dilute Lidocaine, epinephrine and sodium bicarbonate were administered.

The area was divided into six 5X5 cm treatment squares. The deep tissue was treated with 30 Watts of the 1064 and 20 Watts of the 1320 using Smartlipo MPX. 15 Watts of the 1064 nm and 10 Watts of the 1320 nm wavelengths in MultiPlex were applied to the superficial tissue. An average energy of 845 total joules was delivered to reach treatment square.

The patient tolerated the procedure well. Her bruising erythema, swelling, tingling and discomfort all resolved by day 4. She was pleased with her results at one month.

Patient 3

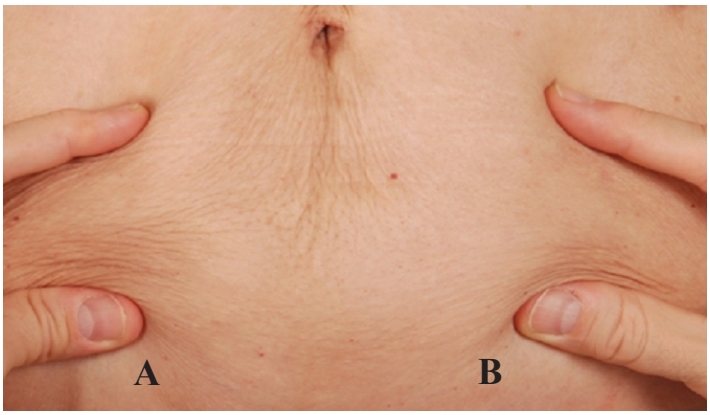
Patient 3 was a 59 year old female patient who desired tightening and reduction of her excess adiposity of the abdominal area.

Standard pre-operative procedures were employed and she was taken to the operating room where a total of 2010 cc of tumescent anesthesia was administered.

Additionally, 5x5 cm squares were drawn with a surgical marker covering the entire area to be treated. On the right side laser, energy was administered to the deep fat tissue using the MultiPlex mode with settings of 30 Watts for the 1064 nm component and 20 Watts for the 1320 nm wavelength. As the tissue became pliable, the deep lasing was stopped. On the left side, the deep fat was treated with the same parameters as the right side, but superficial lasing was also performed with 10 Watts of the 1064 nm and 1320 nm wavelengths using the MultiPlex mode. As superficial lasing was performed, the laser fiber was brought closer to the surface and the aiming beam was clearly visible on the surface of the skin. The superficial lasing stopped when a skin became pliable. Laser lipolysis was then followed by traditional aspiration and the patient tolerated the procedure well.

The patient tolerated the procedure well. At the one week and one month follow-up we noted that the left side where superficial lasing was performed, greater skin tightening had occurred due to tissue tightening as compared to the right side which was not treated subdermally.

Figure 3



A (left) Untreated and B (right) 1 month post Tx

Discussion

In 2006 (annual report from the American Society for Aesthetic Plastic Surgery (ASAPS) nearly 11.7 million surgical and non surgical cosmetic procedures (including laser treatments) were performed in the US alone[8]. Liposuction was the most common surgical cosmetic procedure in 2007 with a total of over 456,000 procedures performed[8]. With advancements in laser technology a new laser lipolysis procedure, Smartlipo with MultiPlex provides a less invasive method to perform body contouring and liposculpting.

The Smartlipo MPX, offering two distinct wavelengths, is a safe and effective procedure for laser lipolysis and skin tightening. The combination of wavelengths appears to

increase the speed and efficiency of disrupting the adipocytes. The laser tissue interaction supporting the addition of the 1320 nm wavelength to the current 1064 nm Nd:YAG system is based on the strong absorption and minimal scattering characteristics of the 1320 nm wavelength in fat tissue allowing the majority of the energy to be deposited in a localized region near the laser fiber tip in the subcutaneous layer. This results in efficient heating of the subcutaneous layer and effective lipolysis.

The 1064 nm laser has less absorption and larger scattering than the 1320 nm counterpart allowing for disruption of a broader region of fat tissue. The 1064 nm wavelength heats tissue more evenly while generating broader heating zones than the 1320 nm wavelength. Sequential lasering with both wavelengths in the MultiPlex mode, not only generates higher temperature rise at the front of the laser tip but also heats peripheral tissue. It allows for more efficient lipolysis, and safer and more efficient heating of collagen bundles in the dermis resulting in tissue tightening.

Skin tightening has been previously demonstrated when treating the abdominal as well as the submental area. The skin tightening aspect of the laser is demonstrated in the third case study where superficial laser energy was only used on one half of the treatment area. Thermal denaturation of structural proteins in fresh tissue has been reported at 40 – 45 degrees Celsius[10]. Due to lasing in the dermal plane, temperature may rise delivering additional heat to the dermis. Thus, our lasing was stopped when the skin temperature reached 38-40 degrees Celsius.

Laser lipolysis performed by the Smartlipo MPX has demonstrated increased safety and less recovery time compared to traditional liposuction. This advanced technology has the ability to provide better results than traditional liposuction with impressive visual skin tightening as exemplified in case study patient #3. As the demand for cosmetic procedures continues to grow, Smartlipo MPX will increasingly become a choice for safer more comprehensive and efficient and effective laser lipolysis.

Conclusion

Smartlipo MPX is a safe and effective method for laser lipolysis.

Sequential laser exposure with this combination (MultiPlex) is thought to be more effective than either laser alone by decreasing the time of treatment needed allowing the surgeon to treat larger regions of tissue at varying depths and increasing the efficacy and safety profile of the laser for skin tightening treatment.

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