
A Smartlipo® Compendium
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Introduction

A foreward written by Barry DiBernardo, MD and Alberto Goldman, MD
While not a total replacement for tumescent liposuction, laser-assisted lipolysis benefits patients specifically looking to treat stubborn areas of fat, or who are not indicated, receptive or in need of more invasive traditional liposuction which uses larger cannulas. In contrast, the use of a laser-guided technique affords patients less blood loss, a shorter recovery time frame, less edema, and decreased pain and discomfort in the post-treatment period.

The most extensively studied, used and validated laser-assisted lipolysis system is the Smartlipo Laser-BodySculpting™ Workstation (Cynosure, Inc, Westford, MA).

The first platform of the Smartlipo technology used a 6 Watt 1064 nanometer neodymium-doped yttrium aluminum garnet (Nd:YAG) laser. Today’s platform includes the use of three clinically proven wavelengths (1064nm, 1320nm and 1440nm at 40W, 24W, 15W of power respectively) delivered in a blended fashion that utilizes the benefits of all three wavelengths. Most importantly, these wavelengths are delivered utilizing high peak powers to deliver the optimal energy to disrupt fat and coagulate blood vessels. Extensive clinical and histological data support the effectiveness of this laser, and while numerous other lasers have followed Smartlipo to market, none are supported with the substantial body of evidence that Smartlipo has accumulated.

According to the Centers for Disease Control and Prevention, nearly two-thirds of US adults are overweight, and nearly one-third of the population is considered obese. Given these trends, patient demand for laser-assisted lipolysis is only likely to rise. Recognizing the trend for minimally invasive procedures, physicians have utilized laser-assisted lipolysis to help patients achieve their desired body contour, with minimal downtime and a high degree of satisfaction. Due to patient satisfaction and the minimally invasive nature of this procedure, there is a new set of patients considering a laser lipolysis treatment.

This compendium was designed to present clinical and histological research and results that demonstrate the benefits and applications of the Smartlipo technology as a reliable, treatment for the removal of unwanted fat. We have divided the research findings into five main categories:

**Scientific Rationale**

This section outlines the science-backed basis behind the 1064 nm Nd:YAG technology and the blending
of the 1064 nm 1320nm and the 1440 nm wavelengths in performing laser-assisted lipolysis. In our experience, the action of photothermia, in which laser light is converted into heat energy when absorbed by adipose tissue and photomechanical effects is what makes the Smartlipo laser effective in the disruption of fat. Furthermore, the positive benefits of the blended 1064nm, 1320nm and 1440nm wavelengths have been clearly demonstrated in recent clinical studies.

Clinical Utility
In this section, we review how Smartlipo, the first laser introduced to the market for interstitial laser lipolysis, has been shown to produce less pain, bruising and faster recovery times than liposuction alone. Goldman, Kim and others observed that the use of Smartlipo results in a less traumatic outcome than with conventional liposuction.

Optimal Patient Selection
In our experience, and as with any medical intervention or treatment, the success of Smartlipo procedures depends on determining the best candidate, area for the procedure, skill of the physician and setting the right expectation for the patient. In initial studies it has been shown that patients looking to treat only localized areas or who are hesitant to proceed with more aggressive procedures represent the ideal target group. In addition, patients with areas of skin laxity are ideal candidates for Smartlipo treatments. Patients who are already close to their ideal weight and for whom maximum aspired volume doesn’t exceed 5% of body weight, laser-assisted lipolysis is a favorable course of treatment (Goldman, 2002). Since that time, the technology has evolved, allowing physicians to treat larger areas with better accuracy and safety.

Recent Smartlipo Advancements
The 1064 nm 1320nm and the 1440 nm Nd:YAG laser has been shown in clinical research to deliver reproducible results. The Smartlipo TriPlex™, a system offering all three wavelengths, has been shown in documented clinical use to provide faster, safer and more effective delivery of energy. Furthermore, physicians report that the current Smartlipo workstation can coagulate soft tissues in the face, as part of a Smartlifting™, SmartLook™ breast lift or body procedure. Sweat glands associated with hyperhidrosis, soft tissues associated with cellulite, lipomas, and gynecomastia can also be treated with Smartlipo. Further studies are underway to explore other applications in the use of this technology. Cynosure’s creation of innovative temperature sensing intelligent delivery systems, like ThermaGuide have allowed the surgeon to easily identify safe temperature thresholds for more consistent clinical outcomes. The ability to accurately target specific temperatures has improved the effects of the laser as well.

The Future of Smartlipo
Laser lipolysis is an exciting area in the field of aesthetic medicine, and is poised for continued expansion and scientific advancement.

In addition to an overview of peer-reviewed articles, this compendium also provides patient case studies featuring before-and-after photos, as well as a series of white papers. We invite you to review these materials thoroughly and discover how, with the support of extensive clinical and histological evidence, the Smartlipo TriPlex™ is a technology you can use with confidence for your patients, both today and tomorrow.

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Laser lipolysis is an exciting area in the field of aesthetic medicine and is poised for continued expansion and scientific advancement.
The goals for seeking new tools and alternative methods include reducing downtime, decreasing operator effort for surgeon and assistant, reducing bleeding, promoting tissue tightening, and facilitating treatment of fibrous areas (Goldman, 2006). Adoption of laser technology to treat localized fat was first described in 1994 by Apfelberg (Apfelberg, 1994), whose results helped lead the way to FDA approval (Goldman, 2002). Badin also published her experience emphasizing the benefit of tissue retraction obtained with laser lipolysis (Badin, 2002).

Clinical data

According to the clinical data reviewed in this document, the goal of maximum efficacy with minimal harm has been met, if not exceeded, by use of the 1064 nm, 1320 nm and 1440 nm wavelengths.

As the leading laser in a growing field, the 1064 nm Nd:YAG laser has been shown to successfully target selected areas of fat for destruction while simultaneously causing tissue coagulation, resulting in tissue tightening. Its use in liposuction has been proven to offer freedom from the current limitations with the promotion of better hemostasis, better wound healing and reduced surgical trauma (Badin, 2005).

A decade’s worth of its use in Europe and South America for local areas with moderate flaccidity has been favorable (Kim, 2006).

Topics under review

This section reviews data and clinical publications from the medical literature on the following topics: Mechanism of Action, Stages of Laser Lipolysis, Physics of Laser Lipolysis, Theory of Selective Photothermolysis, and SEM and Histologic Findings.

Eight corresponding peer reviewed studies are described in abstract form in Appendix A and B.

Mechanism of Action

Laser energy at a prescribed wavelength, transmitted through a flexible optical fiber to adipocytes, has been shown to rupture the adipocytes by absorption of the energy of the laser. Analysis of the effects of Nd:YAG lasers on human fat tissue has also shown that the lasers cause areas of cellular damage, cell lysis and reduced bleeding (Badin, 2005).

The mechanisms leading to laser lipolysis are dependent on temperature and photomechanical effects. Because the lipid bilayer components of the fat cell membranes are held together only by forces of hydration, the lipid bilayer is most vulnerable to heat damage. Several studies have also shown that the total energy applied to a volume of tissue is the major determinant of treatment outcome in terms of fat volume reduction. (See figures 1-4)

The mechanism of action of laser lipolysis is selective photothermia. In this process, laser-light energy is converted into heat energy when absorbed by fat. Transmitted through a flexible fiber optic through a
cannula, the laser energy is delivered to the adipocytes, which absorb the energy and rupture. (Goldman, 2006).\(^{(18)}\)

In addition, cells lyse due to photo mechanical effects. The pulsed laser format of the Nd:YAG laser causes photo-mechanical waves to form at the tip of the fiber which physically disrupts the adipose tissue. The effects are magnified with the 1440nm wavelength due to its high absorption in adipose tissue (DiBernardo, 2010)\(^{(20)}\).

Laser lipolysis works through a combination of these photomechanical ablation and selective photothermalysis effects. The greatest amount of thermal damage has been seen in specimens with the highest energy per pulse, however...further studies are warranted (Khoury, 2008)\(^{(42)}\).

Analysis of the effects of Nd:YAG lasers on human fat tissue has also shown that the lasers cause areas of cellular damage, cell lysis and reduced bleeding.

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**Stages of Laser Lipolysis**

The stages of laser lipolysis are illustrated on the left. (Katz, 2007)\(^{(39)}\)
Physics of Laser Lipolysis

There are three important parameters to consider for laser lipolysis to occur effectively:

1. Wavelength Choice
2. Thermal effect through energy level
3. Photomechanical effects

Wavelength choice is based primarily on the chosen target’s (or chromophore’s) ability to absorb energy from the laser. There are four important targets to consider for efficacy in LaserBodySculpting: Methemoglobin, Hemoglobin, Adipose Tissue (fat cells) and the Dermis (skin).

Adipose tissue is composed of more than just fat alone; it also contains 20% water. The dermis is composed of approximately 70% water.\(^1\) It is important to consider these absorption properties of the tissue, as opposed to the components for the tissue alone when selecting a wavelength for laser lipolysis. Figure 5 shows the absorption coefficients for each of these important laser lipolysis targets.

The 1064 nm wavelength has been proven effective for use in hemostasis as well as the disruption of adipocytes and tissue coagulation by over 8 years of peer-reviewed articles and various publications. The 1320 nm wavelength has an even greater affinity for adipose tissue.

“The efficacy of pulsed 1064 nm and 1320 nm Nd:YAG treatment does not depend entirely on the optical adsorption properties of fat...the short pulsed nature of the energy generates a non-linear explosive tissue interaction at the tip of the optic fiber delivery device. This photomechanical ablation causes rapid tissue disruption with minimal coagulation when compared to the same laser used in continuous or heating mode of low-energy-per-pulse delivery” (Khoury, 2008).\(^42\)

Studies have demonstrated that larger volumes of adipose tissue are destroyed when larger amounts of energy are used (Ichikawa, 2006).\(^36\) Therefore, it is also important to consider the level of energy which can be applied to a treatment area during laser lipolysis.

The energy applied to the treatment area is transformed into heat, therefore, the amount of energy required to reach an appropriate treatment endpoint can be verified by monitoring temperature rise. The rate of tissue heating will determine how efficiently the area can be treated.

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 adsorption and minimal scattering characteristics of the 1320 nm wavelength in fat tissue. These characteristics allow the majority of the energy to be deposited in a localized region near the laser fiber tip in the subcutaneous layer (Katz, 2008).\(^40\)
The dramatic photo mechanical effects of the 1440nm wavelength provide more localized heat. So, fatty tissue is disrupted more efficiently with less power (Sasaki; 2010).\textsuperscript{54} The 1440nm wavelength causes photomechanical effects to do its high absorption in adipose tissue—40 times more than 924nm/980nm diode lasers.

Due to the laser interaction with the collagenous tissue and subdermal bands, thermal effects can be seen, including melting and rupture of the bands. This liberates the retracted skin and remolds the collagenous tissue, with clinically evident tissue retraction (Badin, 2002).\textsuperscript{5}

\textquoteleft Two parameters must be considered for laser lipolysis. The first parameter is the wavelength, since the interaction of the laser with the tissue is achieved by the absorption of laser energy by the chromophores, thus producing sufficient heat to cause the desired thermal damage. The heat acts on the fatty cell and the extracellular matrix to produce both reversible and irreversible cellular damage, which facilitates lipoplasty by lessening trauma and bleeding. The second parameter is the energy, since a dose-response relationship exists\textquoteright (Mordon, 2007).\textsuperscript{46}

\textquoteleft The mechanisms leading to laser lipolysis are temperature dependent. First, for low energy and consequently low temperature, only tumefaction of the adipocytes is observed. With higher energy, the histologic assessment carried out by Goldman [and colleagues in 2006] on tissues removed immediately after the procedure showed not only the rupture of adipocytes but also the coagulation of small vessels in the fatty tissue. Because heat is confined inside the adipocyte, it leads to rupture of its membrane. The effect is thermomechanical\textquoteright (Mordon, 2007).\textsuperscript{46}

\textbf{Theory of Selective Photothermolysis}

In addition to wavelength selection and thermal effects, optimal use of the laser energy requires appropriate pulse duration. Based on the theory of selective photothermolysis, the pulse duration must be shorter than the thermal relaxation time of the vessel to achieve effective vessel coagulation (Anderson, 1983)\textsuperscript{1}. The specific pulse structure of the Nd: YAG laser efficiently coagulates blood vessels in adipose tissue. Greater blood vessel coagulation leads to less post operative bruising and swelling. Studies have shown that specific pulse durations of 1064 nm and 1320 nm wavelengths are more effective than continuous wave in preventing bleeding. The high energy pulses from a Smartlipo MPX\textsuperscript{TM} laser with the 1064 nm and 1320 nm blended wavelengths heat the vessel quickly, creating a much higher probability of vessel coagulation. \textquoteleft The ruptured blood vessels exposed to the continuous wave laser continue to bleed since the temperature rises at a slower rate and the peak temperature is lower than that of the Smartlipo MPX\textquoteright (Cynosure Clinical Findings, October 2008).\textsuperscript{10,11} Figure 6 and 7 demonstrate these properties through histology.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{histology_stains.png}
\caption{Histology stains after one day of treatment show small open channels surrounded by lysed adipocytes and thermal coagulated septa. Slides from tissue treated with the Diode CW laser demonstrate more hemorrhaging or bleeding when compared to the tissue treated with the Smartlipo MPX Pulsed Laser. Additional bleeding is evidenced by the increased amount of red blood cells in the tissue.}
\end{figure}
SEM and Histologic Findings

Histology and SEM (Scanning Electron Microscopy) techniques were used in several studies to visualize effects of the Nd:YAG laser in adipose tissue. Histologic findings of tissue exposed to laser irradiation consistently show greater destruction of human adipocytes when compared to control samples after cannulation alone. Histologic samples taken after laser lipolysis demonstrated damage to fat cell membranes and coagulation of soft tissues. These findings suggest several positive benefits of laser lipolysis, including tissue retraction and a reduction in intraoperative bleeding.

“In histologic examination after laser irradiation with the Nd:YAG laser, scanning electron microscopy showed destructive changes surrounding tunnels of about 300 microns, degenerated cell membranes and dispersed lipids” (Ichikawa, 2005).

“Histologic findings suggest several positive benefits of the laser, including tissue coagulation resulting in tissue retraction and a reduction in intraoperative bleeding” (Mordon, 2007).

According to prospective data, “the Smartlipo appeared to be histologically effective for destruction of human fat tissue” (Ichikawa, 2005).

In his 2005 study, Ichikawa demonstrated “greater destruction of human adipocytes than in the control” also “Degenerated cell membrane, vaporization, liquefaction, carbonization and heat-coagulated collagen fibers were observed” (Ichikawa, 2005).

In a second study to evaluate histology and photonics of the Nd:YAG laser for ablation of subcutaneous adipose tissue, Ichikawa and colleagues observed that “tissue evaporation, destruction, heat coagulation and rupture of cell membrane were more frequently seen in irradiated specimens than in controls in scanning electron microscopy. The affected area in the high-power irradiated groups was significantly larger than that of low-powered specimens” (Ichikawa, 2006). Comparison of figures 8 and 9 shows tissue exposed to laser radiation versus the control (cannulation alone).

“The traditional method [of liposuction] produced less reversible cellular effect (swelling) than laser

Figure 8. Scanning microscopy of human specimen after laser irradiation showed destructive changes. Hollows of about 300 µm, equal to the diameter of the fiber, and heat-coagulated collagen fibers were seen (top). Degenerated cell membrane and dispersed lipids were apparent (center and bottom). Scale bar = top and center 100 µm, bottom 10 µm. (Original magnification: top x60; center x200; below x400).

Figure 9. Scanning electron microscopy of human specimens after cannulation without laser irradiation (control). No major structural changes were observed in adipocytes. Scale bar = 100 µm. (Original magnification: top x100; bottom x200).
lipolysis using 1,000 J (∈). The area receiving 3,000 J (∈) showed major damage (cytoplasmatic retraction and disruption of membranes)....The thermal damage produced by the Nd:YAG laser (1064 nm) in the adipose tissue promoted better hemostasis, better wound healing and less surgical trauma” (Badin, 2005). [4]

Evidence of Ruptured adipocytes, coagulated blood vessels, reorganization of the reticular dermis and collagen coagulation are depicted in figures 10-13. (Goldman, 2002) [25]

Tissue evaporation, destruction, heat coagulation and rupture of cell membrane were more frequently seen in irradiated specimens than in controls in scanning electron microscopy.
In addition, this laser has been demonstrated to cause coagulation of blood vessels due to the absorption of energy by hemoglobin. The use of this laser (neodymium: yttrium aluminum garnet, or Nd:YAG) has been found in several prospective clinical trials to produce less pain, bruising and edema, and faster recovery times. The Smartlipo system has also been shown to coagulate a variety of tissues, which leads to tissue tightening.

Smartlipo TriPlex™, the newest laser body sculpting workstation, has been found to produce more effective outcomes similar to Smartlipo through clinical studies. Smartlipo MPX studies have also placed greater emphasis on the measurement and collection of skin elasticity and tissue shrinkage data.

**Topics under review**

This section reviews the existing clinical efficacy data for the 1064 nm Nd:YAG laser system, as it exists in the medical literature.

**Efficacy and Safe Outcomes of Smartlipo Treatments (1064 nm and 1320nm Nd:YAG)**

Several studies have demonstrated a reduction in side effects when laser lipolysis is used to remove localized fat. In these studies, patients experience quicker recoveries, less bruising, bleeding, discomfort and swelling when compared to other lipoplasty methods.

“Laser lipolysis with a 1064 nm Nd:YAG laser, associated with tumescent infiltration using a peristaltic infusion pump, proved to be a method with low meatic loss, a low rate of ecchymosis and little discomfort in the post-operative period” (Goldman, 2002). (25)

“There is less bleeding, swelling and bruising than traditional liposuction and thus a faster recovery time (Goldman, 2002).” (25)

In a study of 245 patients, 6 men and 239 women, where the average age was 35 (range 17-55), results show that Smartlipo was less traumatic than conventional liposuction (Badin, 2002). (5)

Another study of Smartlipo enrolled 1,733 patients, 312 men and 1,421 women, ranging in age from 15 to 78. Goldman and colleagues found that “ecchymoses were less as was blood loss, and patients had less post-operative discomfort” (Goldman, 2002). (25)

Of 29 patients completing the trial, 37% reported an improvement at the 3-month follow-up visit. The most common side effects were mild bruising and swelling, which resolved within two weeks. The investigators conclude that laser lipolysis appears to be a very promising procedure that delivers good, reproducible results safely and effectively. The advantages include excellent patient tolerance, quick recovery time, as well as the benefit of tissue coagulation resulting in dermal tightening.” (Kim, 2006). (43)

“Of 82 patients over a 5-year period, submental laser-assisted liposuction resulted in significant cosmetic improvement.” Also, “complications
were similar to those found with other lipoplasty methods and, in this study, there were no side effects directly related to the laser use” (Goldman, 2006).24

“Laser lipolysis can be used alone for small focal areas combined with liposuction as an adjunct to reduce operator effort and to enhance tissue retraction” (Kim, 2006).43

“Histologic findings suggest several positive benefits of the laser, including tissue coagulation resulting in tissue tightening and a reduction in intraoperative bleeding” (Mordon, 2007).46

“Laser lipolysis performed by the Smartlipo MPX has demonstrated increased reliability and less recovery time compared to traditional liposuction” (DiBernardo, April 2008).12

“A total of 537 patients underwent laser-assisted liposuction (LAL), yielding a complication rate of 0.93%. No systemic complications occurred. Touch ups were required at a rate of 3.5%, ......fewer touch-ups when compared to traditional liposuction alone.” (Katz, McBean 2008)41

Tissue Coagulation Resulting in Tissue Tightening

Tissue coagulation resulting in tissue tightening was evidenced in many clinical trials and studies using Smartlipo. These effects could be observed through patient outcomes and histological slides. More recently, studies using Smartlipo MPX have used improved quantitative methods to measure tissue shrinkage and tissue elasticity before and after treatment.

The benefit of tissue coagulation resulting in tissue tightening has been observed and described in several clinical trials of laser lipolysis (Kim, 200643; Katz, 200759; Goldman, 200626; Badin, 20025; DiBernardo April, 200812 DiBernardo October, 200813 Baxt, 200916; Saddick, 200951; Goldman and Gotkin, 200928; Gentile, 200822; DiBernardo, 200914; Collawn, 201014; DiBernardo, 200917; DiBernardo, 201021; Saskaki, 201055).

In a study of a total of 82 consecutive subjects undergoing the submental laser lipolysis procedure from March 1999 to November 2004, positive benefits included “skin retraction — due to collagen neoformation” (Goldman, 2006).26

“Due to the laser-tissue interaction with the collagenous and subdermal bands, we can see the thermal effects (in histology), including melting and rupture of the bands. This liberates the retracted skin and remodels the collagenous tissue, with clinically evident tissue coagulation resulting in tissue retraction (Badin, 2002).5

In one study, patients were tattooed to measure the tissue shrinkage; results from one patient were described: “The diagonal measurement of the opposite corners of the tattooed square decreased from 6.0 cm to 5.0 cm...on average we have seen 18% tightening of the overall area after 3 months” (McBean, 2009).45 In another study, “the most significant tissue shrinkage was reported as 32% at three months (DiBernardo, 2009).17

“The coagulation of collagen in the adipose tissue and deep dermis, associated with neocollagenesis and reorganization of the reticular dermis, explains the tissue contraction or shrinkage......this is very important in the treatment of patients with some degree of skin laxity who may not be candidates for traditional liposuction.” (Goldman and Gotkin, 2009)28

With laser assisted lipolysis..... we have extended the implications for this minimally invasive surgery to the neck and jowl area. But unlike liposuction alone, we can now offer tissue tightening through coagulation as well.” (Baxt, 2009 6)

“The Smartlipo MPX showed significantly greater tissue tightening and tissue shrinkage through coagulation as compared to liposuction alone.” (DiBernardo, 2009)14

Figure 14 illustrates the benefits of tissue coagulation.
Optimal Selection of patients and anatomical sites is important to the success of laser assisted lipolysis. Patients with skin flaccidity are often ideal candidates.

Due to the evidenced benefits of reduced pain, bruising and edema, and quicker recovery times, laser lipolysis may be suitable to a wide range of individuals, including patients who fear more aggressive procedures, older age groups and patients who require body sculpting after previous procedures. The optimal body part selection includes, unwanted fat areas with focal areas less than 100 cm³ in the neck, tracheal area, abdomen or thighs (Kim, 2006). (43)

Topics under review
This section on optimizing selection reviews patient selection and body selection, as discussed in the medical literature.

Corresponding studies are described in abstract form in Appendix C.

Patient Selection
Laser lipolysis is “an elegant and minimally invasive option for people who want to avoid more perceived ‘aggressive’ procedures such as neck lifts. It may also be helpful in areas not suitable or for focal areas that have already undergone liposuction and require additional sculpting” (Kim, 2006). (43)

In a study of 1,734 surgeries using the Nd:YAG type laser equipment with a 1064 nm wavelength, investigators assert that “the technique was indicated for treating localized lipodystrophy and irregular fat in healthy patients, preferably non-smokers and near their ideal weight. The maximum aspired volume did not exceed 5% of the body weight” (Goldman, 2002). (25)

“The field of candidates expands over that of traditional liposuction because laser assisted liposuction is better able to treat some of those patients with skin laxity that would not have acceptable skin re-draping with traditional techniques.” (Goldman and Gotkin 2009) (28)

Treatment Site Selection
“The treatment of areas that traditionally pose greater difficulty in removing fat, such as the dorsal regions or breasts, in gynecomastia, is made easier, as the microcannula with the laser has a diameter of only 1 mm, and penetration is made easier by action of the laser” (Goldman, 2002). (25)

“The laser can treat areas of high vascularity or where large cannulae might be problematic. Because this laser [medium-pulsed 1064 nanometer neodymium-doped yttrium aluminum garnet (Nd:YAG)] combines fat melting with tissue tightening through tissue coagulation, it can be used for areas where liposuction is indicated but skin laxity might be made worse by traditional methods” (Katz, 2007). (39)

Additionally, “the new method is particularly useful in treating lower abdomen and submental areas where skin laxity may occur after the removal of adipose tissue” (Katz, 2007). (39)

In men, liposuction may be commonly applied to “areas that are quite fibrous, such as breasts, abdomen and hip rolls. Smartlipo™ should be considered as an alterative as it can be less traumatic and decreases the recovery time” (Katz, 2007). (39)

Badin and colleagues reported on utility in “difficult” cases in so-called “forbidden areas” (Badin, 2002). (5) such as the upper abdomen, upper thigh and periumbilical region. Histologically, small vessel coagulation and adipocyte rupture were evident after laser irradiation” (Kim, 2006). (43)
Literature Review

Recent Smartlipo® Research Advancements

The field of Smartlipo candidates has expanded beyond laser lipolysis treatments alone. Smartlipo has been reported to treat soft tissue associated with the following patient concerns: facelifting, facialsculpting, lipomas, gynecomastia, axillary hyperhidrosis, cellulite and interstitial fluid malar pouches.

We have researched additional utilization of the Smartlipo laser to treat various aesthetic and medical conditions, by coagulation of a range of tissues types. We have also seen continued growth in the number of treatment applications. Continuing research is underway to study the effects of the Nd:YAG laser on the underlying causes of a number of aesthetic and medical conditions.

Topics under review

Smartlifting, laserfacialsculpting, which involves use of the laser to tighten facial tissues and to elevate the facial flap, use of Smartlipo to treat sweat glands associated with hyperhidrosis and fibrous tissue associated with gynecomastia and lipomas. Smartlipo may also be used to reduce the Malar fat pads and appearance of cellulite.

Smartlifting™

Smartlifting using a Nd:YAG laser, allows the surgeon to gently separate the layer between the skin and facial muscles without extensive cutting and dissection when performing a rhytidectomy. With the addition of Smartlifting, operating time is significantly reduced since the laser helps to coagulate blood vessels and reduce bleeding before the beginning of the lifting portion of the facelift. This new technique involves applying a laser subcutaneously prior to traditional facial flap elevation. Though more study and significant training in facial rejuvenation procedures are needed, in a study of 130 patients who underwent so-called Smartlifting, the operating time for facial flap elevation was reduced by more than 50%. Postoperative bruising was also reduced (Gentile, 2008). Investigators believe this is a transformational technique.

The tissue tightening* properties of the 1064nm Nd:YAG laser are being used for facial rejuvenation, also known as laserfacialsculpting or SmartLook™ procedures. Laser energy can be applied subdermally where the laser can more effectively heat collagen (Moretz, 2010).

Smartlipo treatment research has expanded beyond laser lipolysis alone.
Ablation of Sweat Glands Associated with Axillary Hyperhidrosis

Axillary hyperhidrosis, or excessive underarm sweating, is a common, but difficult-to-treat, condition. Many treatment options have limited or short-lived effects, leaving patients with no ideal treatment option. Some recent studies demonstrate the use of a 1064 nm Nd:YAG laser to ablate sweat glands can be a safer, more effective treatment option for patients suffering from this condition. “Axillary hyperhidrosis is excessive underarm sweating that is annoying and embarrassing for its sufferers. Hyperhidrosis affects 3% of the population and results from excessive sympathetic nerve stimulation of the eccrine sweat glands. Many treatments are available for this condition, including drying agents, anticholinergics and botulinum toxin injections. Surgical treatments include sympathectomy, which involves ablation of the sympathetic nerve supply to the sweat glands, or liposuction, which removes the sweat glands without affecting the body’s overall ability to cool itself. Smartlipo may be a new and effective treatment for this condition by treating the associated sweat glands” (Katz, 2007).

In Goldman’s recent study the mean area of sweating was reduced from 63 ± 15 to 15 ± 18 cm² and improvement according to mina’s iodine starch test was good or excellent in 81% of the cases. “The treatment of axillary hyperhidrosis using the 1064 nm Nd-YAG laser has the advantage of a minor invasive procedure without leaving large scars and causing temporary impairment. The laser proved itself to be effective and safe,” (Goldman, 2008).

Lipomas

Lipomas are one of the most common benign tumors which are composed of fat cells and occur primarily in the subcutaneous tissue. Once a benign lipoma is differentiated from a liposarcoma, surgical excision of the benign lipoma represents the standard treatment for removal. Surgical excision often leaves a large scar. Smartlipo’s lipolytic activity and less invasive approach has made laser lipolysis a superior treatment option (Goldman 2009).

Malar Pouches

The subcutaneous zygomatic pad or malar fat pad can become ptotic with age and gravity and can be a frequent cosmetic concern. This condition can be difficult to treat with more traditional approaches such as a rhytidectomy or thread suspension. The use of the Smartlipo laser has been documented to reduce the subcutaneous zygomatic pad without facial nerve problems and a lack of skin damage and bruising. Tightening of the skin tissue through coagulation has also contributed to a smooth transition between the cheek and eyelid. “The Smartlipo laser proved to be a useful and versatile tool for the amelioration of this condition” (Goldman 2009).

Cellulite

Many current cellulite treatments have limitations and do not provide a consistently effective improvement in cellulite, but recent studies show a significant clinical improvement of cellulite when treated subdermally with a combination of a 1064nm Nd:YAG laser and autologus fat transplantation. The treatment of elevated areas by the disruption of fat cells with the pulsed 1064nm Nd:YAG laser, and the use of autologus fat to fill out the depressed areas has presented a viable option for the improvement of severe cases of cellulite (Goldman, Gotkin, Sarnoff 2008). In addition, the laser’s effects on the fibrous septal connective tissue layer stimulate a contraction and tissue tightening through coagulation. The alteration of these connective tissues is a further beneficial effect of the Smartlipo laser.

Treatment of Fibrous Tissue Associated with Gynecomastia

Gynecomastia is a common problem in the United States. Current figures estimate 36-40% of men have excessive glandular development and adipose tissue. In addition, obesity can complicate this issue (Schafer, 2007). Current treatment involves surgical excision of the adipose tissue, leading to scarring and skin laxity. Recent studies have demonstrated that a Smartlipo procedure can reduce breast tissue and skin laxity and leave minimal scarring. “Post Surgical photographs showed reduction in breast tissue volume and more masculine appearing chests compared to presurgical photographs” (Schafer, 2007).
Laser lipolysis is an exciting area of growth and scientific advancement. The clinical research produced thus far has shown this specific technology (1064 nm, 1320 nm, and 1440 nm) will deliver faster, excellent, reproducible results with benefits to patients and practitioners.

The recent advancements in the technology today represent improvements in speed (power), efficacy (triple wavelengths) and reliability (intelligent delivery systems). The future state of this technology includes continued clinical research to further optimize the delivery of energy to address the skin and adipocyte tissue.

**Topics under review**
This section covers recent research on the latest generation Nd:YAG laser, Smartlipo MPX™, TriPlex and the intelligent delivery systems used for more accurate and reliable clinical results.

The Smartlipo MPX Workstation, offering two distinct wavelengths (1064 nm and 1320 nm), is a safer and more effective procedure for laser lipolysis and tissue coagulation. The combination of wavelengths creates a blended thermal photomechanical action to more effectively liquefy fat and heat collagen. The opportunity to “multiplex” increases the speed and efficiency of disrupting the adipocytes. “Laser lipolysis performed by the Smartlipo MPX has demonstrated increased reliability and less recovery time compared to traditional liposuction. The advanced technology has the ability to provide better results than traditional liposuction with impressive visual tissue tightening” (DiBernardo, Goldman and Sluja, et al., 2008). Figure 17 demonstrates tissue coagulation after superficial lasing versus a control.

Laser lipolysis performed by the minimally invasive Smartlipo MPX laser with the accompanying ability to coagulate tissue is a tremendous advantage to the surgeon and patient.
**Smartlipo TriPlex**

Most recently Cynosure introduced a 3rd wavelength, 1440nm to the Smartlipo platform. Since the 1440nm wavelength has a smaller, more intense zone of ablation, it allows for more specific targeting of the fatty tissue for more efficient aspiration—and leaves remaining tissue intact for improved patient recovery (DiBernardo, 2010)^20^.

**ThermaGuide – Thermal Sensing Technology for Precise Control**

Based on Smartlipo clinical studies, temperature protocols were developed to identify the temperature threshold for reliable and consistent patient outcomes. ThermaGuide now provides the practitioner the ability to easily and accurately target these specific temperatures for optimum tissue tightening effects.

ThermaGuide for Smartlipo was developed with patient safety and improved control in mind. ThermaGuide measures subdermal temperatures and provides this information to the Smartlipo laser. Laser energy is delivered until the target tissue temperature is reached. When ThermaGuide was used closer to the skin “The delivery of energy was targeted and controlled within the superficial laser providing the appropriate margin of safety.” (Mulholland 2009)^48^ Refer to Figure 20.

![Subcutaneous tissue treated with one cannula pass. 1 week after 4W 1440nm radiation. 10x magnification](image)

**Figure 18 & 19**

**Histologies:** 1440nm vs. 1320nm

**Figure 20.** ThermaGuide was set to an initial warning temperature of 40°C. When tissue temperature exceeded 40°C, laser emission was automatically stopped as indicated by the grey bars. When the ThermaGuide cannula was moved to a different area where temperature was below 40°C, laser emission automatically resumed, ensuring a safe and consistent outcome.
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. 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.

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. 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 unwanted fat and tissue 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 techniques 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 photomechanical 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.

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 nonsmoker, 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).
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 each 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 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 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.

Laser lipolysis was then followed by traditional aspiration utilizing a 2.5 mm suction cannula with negative pressure around 350 to 450 mm Hg. 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 postoperatively. Baseline triglyceride levels were 88, 108 at 1 day, 106 at 3 days and 106 at 1 week posttreatment.

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 nonexposed 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.

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 each 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
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.

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

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 (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.

Discussion

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

Smartlipo MPX is a safe and more 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 tissue tightening treatment.

References

Introduction:

Less invasive procedures for facial rejuvenation are becoming more and more popular as prospective patients seek out treatment options that offer the best-possible results with the least amount of downtime. As the demand for procedures increases and patients spend more time researching options, more informed choices are being made and many times patients opt for technologically advanced procedures. Patients are more likely to undergo these types of procedures since they reduce risk, specifically anesthetic risks. One such option is Laser SmartLifting™, which utilizes the Smartlipo™ laser for laser lipolysis and tissue tightening through tissue coagulation.

SmartLifting™ is a new application designed as an adjunct to advanced surgical facial rejuvenation procedures such as Rhytidectomy. It provides a revolutionary and minimally invasive procedure using a high peak-powered laser to aid in tissue separation with simultaneous tissue tightening through tissue coagulation. Procedures utilizing SmartLifting™ are associated with less downtime and side-effects due to reduced tissue trauma and surgical time.

Several patients were also treated with an even less invasive approach called the UltraMiniLift™. This procedure works well in the younger patient who is interested in a minimally invasive surgical approach to correct early jowling.

Until early 2008, most in office procedures which included Smartlipo techniques, were completed by using the laser for laser lipolysis and the concurrent tightening of the facial soft tissues through tissue coagulation that follows laser lipolyis. One patient in particular had a specific interest in receiving Smartlipo treatment to slim her neck which had quite a bit of pre-platysmal and sub-platysmal fat with concurrent laxity. When examined further a recommendation for a minimally invasive approach to tighten her mid and lower face in addition to a neck rejuvenation procedure was made. It was unknown whether or not the laser would effect her significant acne scarring (See Figure 1A). After fully disclosing the nature of the laser’s use for these conditions, it was determined this patient’s presentation represented an ideal candidate for a minimally invasive “Smartlipo” lift.

Over the past years the approach to the Superficial Muscuo-Aponeurotic System (SMAS) in our Mini-Lift procedure was streamlined and we began implemmentation of the Quill-SRS sutures for a vertically oriented SMAS plication. We found the Quill-SRS sutures to be very helpful in correcting significant neck laxity as well as improving volume in the malar and submalar regions.

Figure 1A (left) & 1B (right). Patient is shown three weeks before and after SmartLifting of face and Smartlipo of neck.
The combination of these two advancements, SmartLifting™ and Quill SRS sutures, provides the surgeon a more comprehensive set of techniques, which produce dramatically more efficient and effective clinical outcomes.

**Methods**

Cynosure’s Smartlipo or Smartlipo MPX™ laser was applied subcutaneously prior to traditional facial flap elevation for rhytidectomy or forehead rhytidectomy and neck lifts. A 1064nm Nd:YAG Smartlipo system, was utilized in the initial stages of the study to irradiate the subcutaneous tissue, since the Smartlipo system is cleared by the FDA for subcutaneous use. A 600-micron optical fiber was introduced into a 1-mm diameter stainless steel micro-cannula of variable length. The laser was fired through the distal end of the fiber which protrudes 2 mm beyond the tip of the cannula. The distal end of the fiber interacts with the facial and neck soft tissue. For visualization purposes, an aiming laser source is provided in the beam path providing the precise location of the fiber tip, indicating where the laser is working.

For most facial and neck anatomical regions, a 6W-12W, 100μs pulsed laser at 40 Hz and 150 mJ was used. The Smartlipo MPX laser, which is capable of blending both the 1064nm and 1320nm wavelengths was used in more recent studies. The Nd:YAG laser produced photomechanical and thermal effects, which dissected the tissue quickly and easily. In addition, the Nd:YAG laser’s hemostatic properties allowed for the coagulation of small blood vessels in the subcutaneous plane with preservation of the dermal plexus of vessels. SmartLifting™ permitted flap separation in typically difficult to reach areas such as the nasal labial folds and the corner of the mouth when completing “full rhytidectomy”.

**The LaserSmartLift™ Technique**

After local anesthesia with epinephrine was injected to the surgical site, the procedures began with a standard flap elevation of 5.5 cm from the tragus. A modified Klein’s solution was used to hydro-dissect and further vasoconstrict the flap. The Smartlipo laser was then used to separate the skin and dermis from the SMAS by creating multiple “microdissection tunnels.” Three portals, including the temporal, which is adjacent to the lobule and posterior auricular, were used to introduce the laser (See Figure 2). When the skin was noted to be mostly loosened from the SMAS and the incisions were complete, the flap is easily dissected with minimal bleeding. The need to use the cautery during flap elevation was very rare. The flap was elevated in an average of 4 to 5 minutes and in some patients it was elevated in as little as 2 minutes. After the flap was adequately elevated and mobilized, Quill-SRS sutures were used to elevate the jowl and upper neck. Occasionally a small purse-string neck plication was used at the level of the mandibular angle. This technique termed a LaserSmartLift™ is a mini version of a standard lift with variable length incisions past the retroauricular sulcus.

**The UltraMiniLift™ Technique**

The incision for the UltraMiniLift™ was extended from the temporal hair tuft to the mid tragus level. LaserSmartLifting™ was conducted and Quill suturing was performed as described for the LaserSmartlifting procedure. The improved hemostasis facilitated by SmartLifting the flap allowed the surgeon to address the SMAS through such an extremely small incision without significant concerns about such limited exposure for vessel coagulation.
Results

After the SmartLifting™ technique was used to lift the facial flaps, almost no bleeding on either side was encountered (See Figure 3). The first patient described also had significant dermal fibrosis from her extensive acne scarring (See Figure 1B). After the initial success of the first procedure, it was decided to utilize the SmartLifting™ technique in all facial rejuvenation procedures including forehead rhytidectomy and it continued to be significantly useful for all the procedures performed.

SmartLifting™ was also used for festoons and malar crescents as well as residual fullness after blepharoplasty procedures. A before and after view of a recent patient is shown in Figure 4.

The addition of the Smartlipo MPX laser resulted in less bleeding than traditional flap elevation techniques such as scissor vertical spreading techniques. Operating time for flap elevation decreased by more than 50%, according to a retrospective review of over 130 patients the preliminary study. Many patients also experienced less post-operative bruising and some were able to return to work in as little as three days.

The SmartLifting™ procedure disrupted the soft tissues usually in the area between the subcutaneous plane and the superficial muscular aponeurotic system (SMAS) or superficial fascial layers. Flap separation was also possible in typically difficult-to-reach areas such as the nasal labial folds and the corner of the mouth when completing full rhytidectomy.

The SmartLifting™ technique also facilitates tissue separation complicated by scar tissue and fibrosis during secondary rhytidectomy. Scar tissue and prior surgeries were also more easily completed with SmartLifting™ due to the ability of the Smartlipo laser to lase through scar tissue.

The Smartlifting™ technique has been utilized in over 130 procedures since early 2007 (Refer to Table 1). These procedures included face, neck and forehead treatments as well as concurrent use in sub-platysmal fat ablation and muscle ablation during endoscopic forehead procedures. There have been very few complications in the earliest patients treated with the Smartlipo 6 and 18 W systems. The higher power and dual wavelengths available on the Smartlipo MPX, have increased the ablation capabilities of the laser, but lower power settings must be used to prevent complications. At the conclusion of this study, there has been one minor epidermal thermal injury during a procedure, which occurred adjacent to the lateral orbital rim, an area that was not injected with tumescent fluid.

Table 1. Smartlifting™ has been utilized in over 130 procedures since early 2007

<table>
<thead>
<tr>
<th>Procedure Area</th>
<th>Times Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>LaserSmartLift</td>
<td>46</td>
</tr>
<tr>
<td>UltraMiniLift</td>
<td>5</td>
</tr>
<tr>
<td>Forehead/Depressors</td>
<td>17</td>
</tr>
<tr>
<td>Neck</td>
<td>43</td>
</tr>
<tr>
<td>Festoons</td>
<td>3</td>
</tr>
<tr>
<td>Subplatysmal Fat</td>
<td>6</td>
</tr>
<tr>
<td>DAO Ablation</td>
<td>5</td>
</tr>
<tr>
<td>Lip Crease Sub-Surfacing</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>130</strong></td>
</tr>
</tbody>
</table>
Discussion and Conclusion

SmartLifting™ utilizing the Cynosure Smartlipo and Smartlipo MPX lasers promises to be very useful for Facial Plastic Surgery procedures such as facial, forehead and neck lifts. The primary utility of this technique results from the significant hemostatic effect the laser has when used to microtunnel the surgical plane between the dermal-subcutaneous plane and the SMAS. In addition to the substantial and beneficial hemostatic effects of the laser the thermodynamic changes induced by the laser in the dermis, Smartlipo MPX also contributes to a significant tissue tightening through tissue coagulation which is not possible in traditional face, forehead and neck lift procedures. The addition of state of the art self retaining sutures for jowl and neck correction to the increased hemostasis and tissue tightening effects of the laser constitutes the technical triad we have called the SmartLifting™ technique. Surgeons and patients were very pleased with the natural results obtained (See Figures 5 and 6) from this procedure. In all patients studied the operating time for facial flap elevation was reduced by more than 50%. The reduction in procedure time was due to the decrease in bleeding from the flaps where the SmartLifting™ with Smartlipo MPX was used. Post operative bruising was also reduced. Smartlipo MPX is recommended as the preferred laser for SmartLifting™ procedures.

Looking forward, new protocols are being developed to maximize the enhanced coagulation properties inherent in the Smartlipo MPX laser while minimizing the potential for collateral thermal damage to the neural and cutaneous anatomy.

Since the LaserSmartLift™ technique requires just over an hour to complete and only mild sedation it can be a valuable tool for surgeons performing facial rejuvenation procedures. Surgeons considering adding SmartLifting™ procedures to their armament should be aware that the procedure requires advanced surgical skills in facial rejuvenation procedures such as rhytidectomy forehead rhytidectomy and neck lifts, and should not be attempted by surgeons not trained fully in advanced facial rejuvenation procedures.

White Paper

Tissue Treated with Continuous Wave Laser Results in More Bleeding When Compared to Tissue Treated with Smartlipo MPX™

Histological evidence from a recent clinical study demonstrates increased amounts of red blood cells in adipose tissue after diode laser treatment.

Methods

Mini pigs were treated subdermally with two different lasers on both sides of the body. The cannula was placed through one incision point and passed through the tissue to create several individual laser channels. Five passes with equal spacing were made in each of several quadrants. Biopsies were excised after one day of treatment. Histological H&E stains were performed.

Laser Settings

980 nm Diode Laser Max Power output: 20 W
Smartlipo MPX Laser Max Power Output: 30 W

Results

Histology stains after one day of treatment show small open channels surrounded with lysed adiposites and thermal coagulated septa. Slides from tissue treated with the Diode CW laser demonstrate more hemorrhaging or bleeding when compared to the tissue treated with the Smartlipo MPX Pulsed Laser. Additional bleeding is evidenced by the increased amount of red blood cells in the tissue.

Figure 1. Schematic of laser channel biopsy locations from sections of tissue. Top image: 980 nm CW 20 W biopsy at B1. Bottom image: Smartlipo MPX 30 W biopsy at B1.
How Do Different Pulse Durations Affect Bleeding During Laser Lipolysis?

Continuous wave laser results in more bleeding

The high energy pulses from the MPX laser heat the vessel quickly, creating a much higher probability of vessel coagulation. The blood vessels exposed to the continuous wave laser continue to bleed since the temperature rises at a slower rate and the peak temperature is lower than that of the Smartlipo MPX.

![Figure 2. Continuous wave laser destroys blood vessels with little coagulation of the vessel. Blood continues to flow into the tissue causing more swelling and edema.](image)

![Figure 3. Pulsed laser energy rapidly coagulates the broken vessel tissue to minimize bleeding.](image)

**Smartlipo MPX and the Theory of Selective Photothermolysis**

Optimal use of the laser energy requires appropriate wavelengths, pulse duration and level of energy. Based on the theory of selective photothermolysis, the pulse duration must be shorter than the thermal relaxation time of the vessel to achieve effective vessel coagulation.* Due to the specific pulse duration of the Smartlipo MPX, it is more effective than continuous wave.

* Smartlipo MPX pulsed laser modeled at 10 W, 40 Hz, 250 mJ/pulse, 0.35 ms pulse duration. Diode 980 nm continuous wavelength modeled at 10 W, 250 mJ delivered an equivalent pulse duration of 25 ms.

![Figure 4.](image)

1. The pulse structure of the Smartlipo MPX provides a shorter pulse duration than the thermal relaxation period.
2. Continuous wave does not provide the peak temperature level to achieve consistent coagulative effect.
Smartlipo MPX pulse duration demonstrates optimal hemostasis in comparison to continuous wave

"The Smartlipo MPX pulsed laser showed a significant difference in its ability to coagulate blood vessels when compared to the continuous wave diode laser. The area treated with Smartlipo MPX showed less bruising, swelling and quicker recovery" – Richard Gentile, MD

Methods

Following the administration of tumescent solution, the laser systems were used to disrupt soft tissue between the subcutaneous plane and the SMAS or superficial layers for facial rytidectomy in a procedure also referred to as Smartlifting.

The left side of the face was treated with Smartlipo MPX at 10 Watts for 10 minutes and the right side was treated with a 980nm continuous wave at 10 Watts for 10 minutes.

Results

More bleeding was observed on the side treated with the 980nm continuous wave laser. 10 sponges were used for blood absorption on the continuous wave side in comparison to 3 sponges used for the Smartlipo MPX pulse laser.

The side treated with Smartlipo MPX presented less bruising and swelling post operatively than the side treated with the continuous wave.

What is Smartlifting?

- Smartlifting provides a revolutionary and minimally invasive procedure for facial rejuvenation. A high peak-powered laser is used to aid in tissue separation with simultaneous skin tightening through tissue coagulation.

- A facial flap which has been “SmartLifted” can be elevated in as little as 3 minutes. Total time spent on the procedure is reduced by more than 50%.

- The laser’s direct action on pre-separating the tissue (laser dissecting) reduces tissue trauma and contributes to less recovery time for the patient.
Why Did Smartlipo MPX™ Induce Significantly Less Bleeding?

“The Smartlipo MPX workstation produces ultra short pulses and high peak powers. This specific delivery of thermal energy provides the necessary coagulative effect to minimize bleeding, reduce procedure time and promote patient recovery. The continuous wave laser does not have the necessary pulse structure to coagulate the vessel quickly.” – Richard Gentile, MD

Continuous wave laser results in more bleeding

Continuous wave laser destroys blood vessels with little coagulation of the vessel. Blood continues to flow into the tissue causing more swelling and edema

Smartlipo MPX™ pulsed laser with high peak power results in less bleeding

Pulsed laser energy rapidly coagulates the broken vessel to minimize bleeding

Smartlipo MPX and the Theory of Selective Photothermolysis

• Pulse duration of the laser must be shorter than the thermal relaxation time of the vessel to achieve effective vessel coagulation\(^1\). Smartlipo MPX pulse durations meet this requirement.

• High energy pulses from the Smartlipo MPX laser heat the vessel quickly, creating a much higher probability of vessel coagulation.

• Blood vessels exposed to the continuous wave laser continue to bleed since the temperature rises at a slower rate than vessels exposed to the Smartlipo MPX laser.

“ When using the Smartlipo in my face lift operations, I have seen significantly more hemostatic effects and my patients experienced much less postoperative bruising. Thus shorter healing times so they have been very pleased with the results.”

– Darryl J. Blinski, MD, Miami, Fl

I. Anderson RR, Parish S.A. Science 220 (4596) 1983

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White Paper

Smartlipo MultiPlex™ — An Advanced System for Laser Lipolysis

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Juva Skin & Laser Center, New York, NY

Introduction

In October of 2006, the United States Food and Drug Administration approved Smartlipo (Cynosure, Inc., Westford, MA), a medium-pulsed 1064 nanometer Neodymium-doped yttrium aluminum garnet (Nd:YAG) laser for the surgical incision, excision, vaporization, ablation and coagulation of all soft tissues. Laser-assisted lipolysis is now an exciting, effective and safe option for patients and physicians who wish to improve local adiposities while minimizing downtime.

Doctors, patients and the media are excited about this procedure because for the first time, one modality both liquefies adipose tissue and coagulates tissue, resulting in tightening. Patients are pleased with results and the safety record of Smartlipo has been impressive in our experience. However, clinicians continue to search for ways to enhance the efficacy and safety of laser lipolysis even further.

The Smartlipo MultiPlex is the newest generation of laser-assisted lipolysis devices. This technology incorporates two wavelengths, a 1064 nm and a 1320 nm, that fire sequentially in MultiPlex mode to maximize removal of adipose tissue and tissue tightening. The 1064 nm wavelength disrupts a broad region of adipose tissue while heating the treated areas evenly. It also mediates blood vessel coagulation, enhancing hemostasis. In contrast, the 1320 nm wavelength scatters minimally and is robustly absorbed by water in the tissue located near the laser tip. The combination of the two wavelengths creates a blended thermal and photomechanical effect that effectively liquefies fat and heats collagen.

As a result of this latest design, the system provides unique flexibility for the surgeon allowing the use of the 1064 nm or 1320 nm wavelength alone or in succession. Additionally, the Smartlipo MultiPlex is equipped with a unique delivery system that contains an advanced microchip called the Accelerometer inserted into the intelligent hand-piece — SmartSense™. SmartSense reduces the energy output of the laser as the handpiece movement slows.

Figure 1. Before Tx (top) and after Tx (bottom).

Figure 2. Before Tx (top) and after Tx (bottom).
Methods

Twenty patients requesting removal of unwanted fat were enrolled at our center based on the inclusion and exclusion criteria by the Institutional Review Board (IRB).

In order to measure tissue tightening, India ink aliquots measuring 4.0 cm² were tattooed on five of these patients. The purpose of the tattoos was to measure the change in length between corners as well as diagonally between points of the square one month after the procedure. Biopsies were taken from these 5 patients at baseline, 3 days and 1 month after the procedure.

Patients were marked with a surgical marker into several quadrants of equal size prior to the procedure. The sizes of the quadrants varied depending on the treatment locations.

Tumescent anesthesia was administered using the Klein infiltration method.

The laser beam is guided through the fat by a 600 micron optical fiber within a 1.0 mm diameter microcannula which is attached to the handpiece. The optic fiber is extended 2.0-3.0 mm beyond the cannula tip and the energy from the laser is limited to this site. Transillumination of a red helium:neon (He:Ne) beam allows the surgeon to identify the subcutaneous location of the laser tip. The SmartSense is attached to a groove at the base of the handpiece prior to turning on the laser. The Accelerometer can be set to one of three different modes: low, medium or high. Each mode correlates with a different level of sensitivity to the handpiece motion.

The cannula is directed under the skin and a footpedal controls the laser firing. The cannula is passed through the subcutaneous layer in a fanning pattern until the endpoint of reduced adipose tissue thickness is reached.

The laser was applied to each outlined quadrant until the surgeon achieved the desired clinical endpoint. The surgeon’s endpoints are clinically determined by palpation and creation of the optimal contour, and shaping. A thermal camera was also employed to monitor the surface temperature as the laser was applied more superficially in order to promote skin tightening. The thermal camera was connected to a color monitor, which enables the surgeon to identify temperature rise within a particular quadrant. Bluegreen signifies cooler areas while red signifies optimally heated areas.

The temperature range (determined by previous abdominoplasty studies and published literature) that correlated with safety and efficacy of lipolysis was about 40 degrees Celsius. Based on previous studies, temperatures of 47 degrees Celsius and higher resulted in epidermolysis (see Table 1). Typically, a superficial temperature rise to 38-40 degrees was employed as an endpoint. We found that the surface temperature may continue to rise several degrees postlasing as the heat accumulates subdermally.

In order to provide objective endpoints/guidelines, the amount of energy measured in kilojoules was recorded for each quadrant. Specific protocols and treatment settings are being established and will vary depending on patient and treatment areas. The following case details our experience with this new Smartlipo MultiPlex laser system.

Case

A 33-year-old female with excess adipose tissue involving her bilateral hips wished to improve her shape. She had no previous medical history and no prior liposuction to the hips. After an informed consent was obtained, she was photographed, marked with a surgical marker (including quadrants for the purpose of the study) and prepped in sterile fashion. Pre-operative medications were administered. One liter of tumescent anesthesia was infused to each hip.
Once properly anesthetized, a baseline temperature was obtained. Laser lipolysis was then administered to quadrant #1 with 20 watts of 1064 nm and 15 watts of 1320 nm used with the MultiPlex setting to the deep subcutaneous tissue until the tissue was pliable. An end deep temperature was recorded. Subsequently, the laser was administered superficially to quadrant #1 with 10 watts of the 1064 nm and 10 watts of the 1320 nm. An end temperature range between 38 and 40 degrees Celsius was obtained. The treatment was continued in a similar fashion through all quadrants. The lipolyzed adipose tissue was then removed by a power suction cannula.

<table>
<thead>
<tr>
<th>Temperature of onset: ranges °C</th>
<th>Heating times</th>
<th>Histopathologic effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low 40°+</td>
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<td>Edema and hyperemia*</td>
</tr>
<tr>
<td>45°+</td>
<td>minutes to seconds</td>
<td>Thermal denaturation of structural proteins in fresh tissue*</td>
</tr>
<tr>
<td>50°+</td>
<td>minutes to seconds</td>
<td>Damage model prediction of skin damage (epidermal necrosis)**</td>
</tr>
<tr>
<td>50°-90°</td>
<td>minutes to seconds</td>
<td>Change of collagen*</td>
</tr>
</tbody>
</table>

Table 1. Epidermal necrosis and collagen change based on temperature. (Model prediction based on previous studies and literature finding.)

**Results**

Patient postop follow-up time at the time of this manuscript varies from 4 weeks to 6 weeks. Several enrolled patients are nearing the study completion and preliminary results are so far excellent. In the presented case, one month after the procedure, a reduction in fatty tissue volume and improved skin laxity has been observed (see Figure 3). The diagonal measurement of the opposite corners of the tattooed square decreased from 6.0 cm to 5.0 cm one month after the procedure. On average, we have seen 15% tightening of the overall area after 1 month. Early biopsies demonstrate significant disruption of adipocyte membranes. The patient graded her level of satisfaction a 5 out of a possible 5 and would recommend the procedure to friends or family. Additionally, most patients have minimal bruising and pain and return to work in 1 to 2 days.

Figure 3. Before Tx (top) and after Tx (bottom).
Discussion

Laser lipolysis technology continues to improve as clinicians search for faster, more effective and safer ways to remove fat. Laser lipolysis performed with the Smartlipo MPX has demonstrated efficacy and faster recovery time as compared to traditional liposuction.

One potential adverse reaction of laser-assisted lipolysis is excess concentration of laser energy within the irradiated tissue leading to carbonization and thermal burns. We have found that when lipolyzing deep areas, laser energies can be maximized to 20 watts for the 1064 nm and 15 watts for the 1320 nm wavelengths without adverse sequelae.

However, when treating more superficially, decreasing the energy output to 10 watts for the 1064 nm and 10 watts for the 1320 nm provides excellent results and added safety. By blending the two wavelengths in the MultiPlex mode, we are able to generate higher temperatures that heat a broader area while distributing the laser energy more evenly. This results in more efficient lipolysis and safer, more efficient heating of the collagen bundles in the dermis.

For patients at risk for skin laxity after removal of adipose tissue, Smartlipo MultiPlex provides satisfying results. In this study, we demonstrated through tattoos that tissue tightening is a key contribution of laser lipolysis.

Smartlipo MPX is a relatively new technology that has demonstrated reliable tissue tightening and laser lipolysis. Additional studies are recommended to expand the use and knowledge of this system.

References

Currently 36% to 40% of men have gynecomastia (Carlson, 1980). Most cases involve excessive glandular development, an enlarged subareolar region and adipose cells.

Obesity complicates gynecomastia because glandular breast tissue is interwoven with enlarged adipose cells, leading to pseudogynecomastia (Schafer, 2005).

The use of laser-guided liposculpture has gained momentum for removing adipose and glandular tissue in gynecomastia and causing tissue contraction. Although direct excision has been the standard technique for fat removal, this approach is often accompanied by perioareolar scars, skin laxity and other adverse events. The purpose of this study is to evaluate the efficacy and adverse effects of laser-guided liposculpture for the removal of glandular and adipose tissue in gynecomastia. The protocol of this study has been introduced by the author (Schafer, 2005).

Cynosure’s Smartlipo is the first and only commercially available laser-guided liposculpture device. This revolutionary yet minimally invasive device disrupts adipose tissue with a high peak-powered laser that both sculpts body contours and tightens tissue. Compared with current treatment options, the Smartlipo can more easily treat fibrotic and vascular areas, offering reduced downtime and fewer adverse effects.

The mechanism of laser-guided liposculpture has been described by Goldman (2006). A 1064 nm Nd:YAG laser disrupts adipocytes through thermal and photomechanical effects. When adipocytes absorb laser light energy, they convert it to thermal energy which causes the fat cells to expand their volume and rupture. Small blood vessels are also destroyed by coagulation and tissue is tightened through tissue coagulation, resulting in stimulation of new collagen formation. Based on the author’s experience, laser-guided liposculpture can be used in various areas of the body and face, including the mandibular border, submental region, upper and lower abdomen, back, flanks, hips, love handles, pubic area, inner and outer thighs, buttocks, knees, ankles and breasts.

Methods
The breasts of 27 men (aged 30 to 35 years) with gynecomastia were given a single treatment with the liposuction and the Smartlipo device for laser-assisted lipolysis. Most patients were overweight but in generally good health with no history of significant medical problems. Urinalysis and complete blood count were performed before surgery. Patients were restricted to a low sodium diet with no alcohol consumption.
The procedure and expected outcome were explained in detail to each patient during presurgical consultation. Breast areas to be treated were mapped, with the innermost concentric circle indicating the deepest subcutaneous adipose tissue. After IV sedation with meperidine and midazolam, a 1 mm incision was made at the inframammary crease of the axilla.

A cannula was introduced subcutaneously to infuse a solution of saline, lidocaine, epinephrine and sodium bicarbonate. The purpose of this solution (1 liter per breast) was to induce hypertumescence, making the treated tissue less dense for easier removal. Warming the tumescent solution avoided the pain produced by the difference in temperature between the fat tissue and infiltrate.

Fifteen to 20 minutes were allowed for the anesthesia to diffuse and for vasoconstriction to occur. The areas to be treated were morselized using the Bluger man cannula or the Microaire-power cannula for 3-5 minutes on each side until soft. The Smartlipo system was then used on the subareolar bud and remaining fatty and fibrous breast tissue. Once the adipose tissue in the subdermal layers showed minimal resistance to the cannula, energy was then delivered to the dermal layer to create tissue coagulation and tissue contraction.

The Smartlipo uses ultra-short pulses and very high-peak power. The laser energy is conducted to subcutaneous tissue by a 300 micron optical fiber threaded through a 1 mm diameter stainless steel microcannula. When the cannula housing the fiber is inserted in the incisions made for anesthetic administration. The distal portion of the fiber optic was extended 1-2 mm beyond the end of the cannula during treatment. The laser is activated and the cannula is moved slowly and evenly at various depths of the adipose tissue, including the subdermal layer. A He:Ne laser source emitted at the tip of the fiber provided transillumination that permitted the physician to visualize the location of the tip of the fiber optic during treatment.

When treatment was complete, components of the destroyed adipocytes were removed by negative pressure (350-450 mm Hg) through a 2.5 to 3 mm cannula. The small incisions did not require sutures.

After the removal of the destroyed adipocytes, the patients were examined for symmetry between the treated breasts. Diluted triamcinolone (Kenalog) was injected beneath the nipples to reduce swelling. Patients were garmented with a compression and vest to minimize swelling and improve shaping. Nipples were covered with Tegaderm to minimize chafing. Patients were awakened in the recovery room and discharged when vital signs were stable. Patients were evaluated on day one and then at one week, two weeks, one month and three months after surgery, while a subset of patients was evaluated six months posttreatment. Patients were photographed before the procedure and at follow-up visits. Photographs were not graded and measurements were not made on patients before or after treatment. Efficacy and adverse effect assessments were qualitative and based solely on clinical observations. Patient satisfaction was graded on a scale of 0 to 10.

Figure 1. Patient is shown before treatment and six months posttreatment.
Results

Postsurgical photographs showed reductions in breast tissue volume and more masculine-appearing chests compared to presurgical photographs. Clinical examples are shown in Figures 1-3.

Swelling and nipple circumference decreased during the six-month follow-up period. Patient expectations for outcome were met, satisfaction was generally 8 or higher and patients said they would recommend the procedure to friends.

Scarring was limited to a faint 2 mm incision at the anterior axillary line. Neurovascular damage to the areola or surrounding tissue was not observed.

Laxity of skin was significantly reduced and tissue contraction was observed over the six-month period.

Discussion

The photographs and patient satisfaction data show that the minimally invasive Smartlipo procedure reduced breast tissue in gynecomastia men with tissue contraction, minimal scarring and without a chest or areolar incision. The treating physician removed only as much glandular and adipose tissue as needed without damaging the epidermis, musculature or neurovasculature. The result was an attractive masculine appearance and a high level of patient satisfaction in all patients. The effect of the laser within the subcutaneous bed creates a more homogenous effect which results in soft palpable tissue. This provides a much smoother appearance that has significantly reduced revision rates to less than 1%.

Glandular gynecomastia tissue has traditionally been removed by direct excision (Barksy, Pitman, Pitanguy)⁴,⁵,⁶ which, unlike the tumescent lipolytic procedure with the Smartlipo device, has resulted in periareolar scars (Schafer, 2005).² With power-assisted cannulas and liposuction with hypertumescent infiltration, revision rates have been reduced to 1% and all surgeries are all closed (Schafer, 2005).² The Smartlipo tends to reduce and eliminate the subareolar bud, and the need for direct areolar incision and excision of the tissue is not necessary.

Goldman (2006)³ has reported the efficacy of laser-guided liposuction in the destruction of fatty tissue and the stimulation of new collagen formation in the neck and jowls (Goldman).³ Ichikawa and colleagues (2005)⁷ have provided histological evidence of the effects of the Smartlipo on human fat tissue. It is difficult to compare the results of the present study with those of these earlier studies due to differences in study design, evaluation techniques and populations analyzed. However, the two earlier studies and the present study show that the use of laser-guided lipolysis results in cellular lysis and collagen neoformation.

The author believes that a 6 W, 100 μs pulsed laser at 40 Hz repetition rate and 150 mJ energy could also be used for laser-guided liposculpture of most anatomical regions. With the 10 W system, the power, laser action time or both may be decreased for the treatment of small or superficial areas.

The encouraging results of this study justify additional investigations to evaluate the long-term efficacy and safety of laser-guided liposuction in body contouring.
**Conclusion**

Laser guided liposculpture with the Smartlipo is an effective adjunct to the treatment of gynecomastia. The application of the laser creates a smoother result with a significant decrease in revision rates and results in minimal scarring.

**References**


White Paper

Evaluation of Tissue Shrinkage and Tissue Elasticity with the Smartlipo MPX™ Workstation

Barry DiBernardo, MD
NJ Plastic Surgery

Introduction

Lasers utilized for emulsification of fat and coagulation of small blood vessels in conjunction with lipo-aspiration have provided a new approach to body contouring. Papers by Ichikawa1, Badin2 and Goldman3 substantiated the lipolysis and coagulative effect of the Nd:YAG laser through histologic analysis of irradiated fat and tissue sections.

No studies to date have included quantifiable data in order to measure the effects of subdermal application of laser energy on skin elasticity and tissue tightening through coagulation.

Theoretical analysis has been derived from literature regarding the external application of 1064 nm and 1320 nm wavelengths and the clinical and histological effects of fibroblastic activation and stimulation of new collagen formation5. Cytokines and growth factors released by inflammatory cells are thought to correlate with increased collagen production6. The laser can initiate a wound healing response which increases collagen type I and III concentrations. Dang et.al found that 1064 irradiated skin resulted in increased synthesis of collagen type III, while skin treated with the 1320 nm laser had a greater increase of collagen type I due to photothermal effects on the irradiated tissue. In addition, the 1320 nm wavelength had a high scattering coefficient allowing dermal remodeling to occur through increased collagen I deposition with collagen reorganization into parallel arrays of compact fibrils6.

Trelles6 also investigated the histological changes in human skin 6 weeks after 8 treatments with the 1320nm Nd:YAG laser and observed an increase in the number and density of collagen fibers, indicating some compaction in the remodeling process, less interfibrillary space, and good linear orientation of the fibers parallel to the dermoepidermal junction.

Cynosure recently released the Smartlipo MPX laser which sequentially fires 1064nm and 1320nm wavelengths. Based on the wavelength absorption properties, the Smartlipo MPX laser produces a blended thermal photomechanical effect that effectively liquefies fat and coagulates tissue. Thus the combination of wavelength energy achieves maximized results of both removal of adipose tissue and tissue tightening through tissue coagulation7. See Figure 1.

The objective of this study was to gather and analyze data in order to quantify the amount of tissue shrinkage (reduction of area) and tissue elasticity as a result of the effects of a dual wavelength lipolysis laser applied subdermally.

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Figure 1. *Estimation based on the main chromophores in the tissue: Dermis contains approximately 70% water; Human fatty adipose tissue contains approximately 75% lipid and 20% water. (Duck 1990, “Physical Properties of Tissue”, pp.320-328 London: Academic Press)
Methods

Five female subjects with focal areas of adiposity were enrolled in the study, and treated for reduction of localized fat and tissue tightening resulting from coagulation of the abdomen with a Smartlipo MPX™ Workstation, Cynosure, Inc., Westford, MA.

The Smartlipo MPX allows individual as well as sequential emission of 1064 nm and 1320 nm wavelengths through a 600 micron fiber which is extended 2-3 mm from the canula. The sequential firing of these two wavelengths maximizes the attributes of the individual wavelength properties. The combination of these wavelengths 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. 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 of blood vessels.

The accelerometer delivery system, (SmartSense™, Cynosure Inc, Westford, MA), which attaches to the laser handpiece was also used. With SmartSense, the laser is deployed only when the handpiece is in motion and titrates the energy delivered with the motion 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 through controlling the evenness of the energy application.

Candidates were evaluated for mild to moderate skin laxity without structural ptosis. The median age of the subjects was 49 years. All subjects were consented for the procedure and for tattoo markings. Subjects were followed for 3 months.

Digital photographs were taken at baseline, post treatment 1 month and 3 months. Tissue shrinkage was evaluated through photographic documentation and tattoo measurements. Tattoos were applied and objectively measured using the Vectra System (Canfield Scientific, Fairfield, NJ) Linear distance, horizontal, vertical, diagonal and perimeter measurements were documented from the tattoo markings for baseline data and compared to data from 1 month, and 3 months (Figure 2).

3-D Photos of Surfhace Area Measurements

Tissue elasticity was evaluated by using a Derma Lab Suction Cup, (cyberDerm, Media, PA) See Figure 3. This device incorporates a suction cup probe to measure elasticity of the skin. The probe was placed at the center of each tattoo area to take readings.

Figure 2. 5x5 cm² areas were defined by tattoo marks. Photos taken by the Vectra System, Canfield Scientific.

Surface area of the target region is determined by establishing the parameter and determining the surface distance (following the surface contour for each square)

Tissue elasticity was evaluated by using a Derma Lab Suction Cup, (cyberDerm, Media, PA) See Figure 3. This device incorporates a suction cup probe to measure elasticity of the skin. The probe was placed at the center of each tattoo area to take readings.

Figure 3. When suction is applied, the skin is drawn into the chamber. The vacuum pump continues to increase the amount of suction. The skin is lifted to the point where it will break the lower and upper light beams and the pressures required to reach the lower and upper point will be recorded.

Tissue elasticity (Young’s Module) indicated as the tightening index was calculated based on a stress-strain relationship for each measurement.

Subject and Physician questionnaires were completed at 1 and 3 months at which time the tattoos were removed.
**Technique**

Treatment areas were marked into 5x5 cm squares with a surgical marker and each corner was tattooed by India ink delivered by dermal puncture with a 20 gauge syringe.

Subjects were given pre-operative medication; and tumescent anesthesia, consisting of 1000mg of lidocaine, 1 mg of epinephrine and 10 meq of sodium bicarbonate per 1 L of normal saline, was infiltrated into the subcutaneous fat of the pre-marked area. An average of 1550 ml of tumescent anesthesia was used per patient.

Lasing of the deep subcutaneous fat (1-3 cm below the epidermis) was performed first utilizing Multiplex Mode 3 delivering 30 Watts (20 watts of 1064 nm wavelength and 10 watts of the 1320 nm wavelength). Lasing was redirected superficially to the subdermal area (0.5 cm) using Multiplex Mode 1 delivering 16 Watts (8 Watts of 1064 and 8 Watts of 1320 nm wavelength. The lasing continued in a fan like pattern within each 5 x 5 cm square. The endpoint was epidermal temperature of 40-42 degrees Celsius (measure with a hand held infrared thermal camera). Microcannular lipoaspiration was then performed.

**Results**

Subjects tolerated the procedure well. Recovery symptoms were mild to none. Mild swelling was the primary complaint, which was resolved by the three month evaluation in all subjects. The surface areas of tattoos were measured to evaluate skin shrinkage. The most significant tissue shrinkage was reported at three months was 32% with an overall average of 17.2% when compared to baseline.

Tissue elasticity was measured in order to evaluate elasticity changes utilizing DermaLab suction cup. The average increase in tissue elasticity after 3 months was 24% (See Table 2) with 90% of treated areas measured showing marked improvement.

**Discussion**

When used for superficial cutaneous applications, both the 1064 nm and the 1320 nm wavelengths have been associated with fibroblast activity and stimulation of collagen I and III. The Smartlipo MPX system combines both wavelengths in Multiplex mode, which are highly absorbed by both adipose tissue and water.

Previous laser lipolysis studies have shown histological changes such as collagen reorganization and neocollagenesis, which has been attributed to tissue tightening. In this study, subjects achieved marked improvement in tissue shrinkage as well as tissue texture, changes attributed to improvement in tissue elasticity.

<table>
<thead>
<tr>
<th>Tissue Shrinkage (3 months)</th>
<th>Upper Abdomen</th>
<th>Lower Abdomen</th>
<th>Average of Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>14%</td>
<td>7%</td>
<td>11%</td>
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<tr>
<td>Patient 2</td>
<td>26%</td>
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<tr>
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<td>2%</td>
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</tr>
<tr>
<td>Patient 4</td>
<td>22%*</td>
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<td>25%</td>
</tr>
<tr>
<td>Patient 5</td>
<td>16%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td>Overall</td>
<td>16%</td>
<td>18%</td>
<td>17%</td>
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</table>

*Table 1. *Patient 4 lost 10 lbs at 3 months

<table>
<thead>
<tr>
<th>Tissue Elasticity (3 months)</th>
<th>Upper Abdomen</th>
<th>Lower Abdomen</th>
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<tbody>
<tr>
<td>Patient 1</td>
<td>35%</td>
<td>23%</td>
<td>29%</td>
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<tr>
<td>Patient 2</td>
<td>90%</td>
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<td>Patient 3</td>
<td>9%</td>
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<td>-16%</td>
</tr>
<tr>
<td>Patient 5</td>
<td>11%</td>
<td>46%</td>
<td>28%</td>
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<tr>
<td>Overall</td>
<td>20%</td>
<td>28%</td>
<td>24%</td>
</tr>
</tbody>
</table>

*Table 2. *Patient 4 lost 10 lbs at 3 months
In addition, these subjects achieved a significantly higher skin elasticity index (P-value) 26% at three months as compared to pre-treatment. Improvement in elasticity has also been correlated with neocollagenesis. With the understanding of the complexity of skin tissue production, this amount of change is impressive within a short period of time.

The continued improvements to laser lipolysis also need to be correlated to safe use of the high powered technology. Thus, it is important to measure skin surface temperature when treating superficially to ensure that the heat is generated in a consistent safe range. It is recommended that lasing should be discontinued when surface temperature throughout the square reaches 40-42°C. Further, at 0.5mm subdermal depth, the temperature is about 5°C higher and surface temperature will continue to increase as heat rises. However, when treating superficially, skin surface temperature must not exceed 42°C, the point at which epidermolysis may occur. (See Table 3)

With the growing popularity of laser lipolysis it is important that the overall health of the treated tissue is well studied and understood. As the technology increases the demands for tissue shrinkage and improved elasticity is expected, not merely the removal of fat. Based on this study, it is clear that Smartlipo MPX is able to produce both desired effects of tissue elasticity and tissue shrinkage.

**Conclusion**

The Smartlipo MPX is an effective tool for laser lipolysis as well as tissue tightening through tissue coagulation. All subjects included in this study showed marked improvement in both tissue shrinkage and tissue laxity. Overall all subjects were very satisfied with the procedure.

<table>
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<tr>
<td>55 - 90° +</td>
<td>minutes</td>
<td>birefringence changes in collagen *</td>
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Table 3.  

**References**


An Evaluation and Comparison of Tissue Shrinkage and Tissue Tightening: Smartlipo MPX™ vs. Liposuction

Barry DiBernardo, MD
NJ Plastic Surgery

Introduction

Liposuction is accepted as the gold standard for the removal of unwanted fat. More recently, lasers are being utilized as an adjunct tool with lipo-aspiration for the emulsification of fat, coagulation of small blood vessels, and tissue tightening as a result of tissue coagulation.

Ichikawa1, Badin2 and Goldman3 substantiated the lipolysis and coagulative effect of laser lipolysis through histological analysis of irradiated fat and tissue sections. Goldman further reported coagulation of collagen in the fat tissue, reorganization of the reticular dermis and tissue retraction due to collagen neoformation4.

However, no studies to date have included quantitative data regarding the effects of subdermal application of laser energy on tissue elasticity and tissue tightening. The aim of this study was to objectively compare laser assisted liposuction vs. liposuction alone and the affect on tissue shrinkage (reduction of area) and tissue tightening (change in stiffness of skin) resulting from the procedure.

The Smartlipo MPX LaserBodySculpting™ workstation, equippt with SmartSense, was used in this study. The Smartlipo MPX workstation emits sequential 1064nm and 1320nm laser wavelengths to achieve maximum liquification of fat and coagulates tissue to cause tissue tightening. The absorptive properties of these two blended wavelengths, creates a thermal and photomechanical effect which carefully targets the fatty tissue as well as gently heats the dermal layers to remodel collagen.

The SmartSense intelligent delivery system was also used in the MPX study. The SmartSense handpiece delivers the laser energy safely and consistently to the treatment area. The SmartSense delivery system contains a microchip called an accelerometer which senses motion of the handpiece and delivers the appropriate power to prevent excessive thermal damage.

Figure 1

5x5 cm² areas were defined by tattoo marks. Photos taken by the Vectra System, Canfield Scientific. Surface area of the target region is determined by establishing the parameter and determining the surface distance (following the surface contour) for each square.
Materials and Methods

Two subjects were treated for reduction of fat, tissue tightening and tissue shrinkage of the abdomen with the (Smartlipo MPXTM, Cynosure®, Inc., Westford, MA). All subjects consented to bilateral treatments using the laser assisted liposuction or liposuction alone, tattoo marking, and follow-up observation for 3 months.

Both patient and physician were blinded as to the side treated with the laser assisted liposuction versus traditional liposuction and treatment sides were randomized.

Tissue shrinkage was evaluated through photographic documentation and tattoo measurements. Tattoos were applied with a 20 gauge needle using India ink and measurements taken utilizing the Vectra System (Canfield Scientific, Fairfield, NJ). Linear distance, horizontal, vertical, diagonal and perimeter measurements were documented from the tattoo markings for baseline data and compared to data from 1 month, and 3 months. (Figure 1)

Tissue tightening was evaluated through the utilization of DermaLab (CyberDerm, Media, PA) measurement technology. The process incorporates a suction cup probe placed at the center of each tattoo using the DermaLab Suction Cup. (Figure 2) Measurements were calculated by assessing the stress-strain relationship which occurred when suction was applied to the skin and drawn up to a point which coincided with an upper light beam. The pressure differential between the lower and upper point was recorded and the tissue tightening index was calculated.

Lasing on the laser assisted liposuction side of the abdomen was performed using the Smartlipo MPX. The laser energy was applied to the deep subcutaneous fat (1-3 cm below the epidermis) and then redirected superficially to the subdermal area. The endpoint for the treatment of the subdermal layer was an epidermal temperature of 40-42 degrees Celsius (measured externally with a hand held infrared thermal camera). Prior studies by the author have identified 40-42 degrees to be most effective and safest threshold.

The non laser treated side, received a treatment using a small cannula subdermally to mechanically disrupt fat. The cannula was moved back and forth, treating deep shallow fat as well as subdermally for an equivalent amount of time as in the laser treated side. Microcannular liposuction was then performed on the entire area and an average volume of 936 cc of aspirate was removed per full abdomen.

Case Reports

Subject # 1

A 40 year old female, 112 pounds 5’ 1”, skin type II, was enrolled in the study for reduction of her excess adiposity of the abdominal area and tissue tightening. Tattoo marks were applied to measure the change in the skin and baseline measurements were taken prior to the procedure.

Patient was given 20 mg of valium and 10 mg of oxycodone as a pre-op sedative with a sip of water. After 10 minutes, standard pre-operative procedures were employed and she was taken to the operating room where a total of 1275 cc of tumescent anesthesia was administered.

5x5 cm squares were drawn with a surgical marker covering the entire treatment area. The abdomen was divided into two bilateral sections. The right side of the abdomen was treated using Smartlipo Multiplex™ and the left side was treated with sham treatment. On the right side of the abdomen, laser energy was administered to the deep fat tissue using 20 W of 1064 and 10 watts of 1320 nm wavelengths. A total of 40,000 Joules was delivered in the deep fat with an average of 2000 Joules delivered to
each 5x5 cm square. Lasing was stopped when the tissue became pliable. The laser fiber was brought closer to the surface of the skin (where the aiming beam was clearly visible) and superficial lasing was performed using 8 W of 1064 nm and 8 watts of 1320 nm wavelengths. The superficial lasing stopped when a skin temperature of approximately 42 degrees Celsius was achieved. A total of 23,300 pulses were delivered subdermally.

On the left side, the treatment was performed using the same size cannula as in the laser assisted liposuction side and performed in the deep fat and subdermally for the same period of time. The adipose tissue was aspirated from both sides of the abdomen. A total of 730 cc of aspirate was removed from the entire treatment area representing equivalent amounts from each side.

The subject tolerated the procedure well with no reported adverse events throughout the 3 month follow up period. The surface areas of tattoos were compared to evaluate the difference in skin shrinkage, or reduction in surface area, between the area treated with laser and the area that was treated with suction alone.

**Tissue Tightening**

The tattooed area was measured to evaluate the change in skin stiffness. Skin tightening improvement was below baseline at one month for both sides treated with signs of laxity. However, at three months, this subject showed a 175% improvement in tightness on the side treated with laser assisted liposuction as compared to the non laser treated side. Overall, the side treated with laser assisted liposuction had a 324% better result in tightness compared to the side treated with liposuction alone.

**Tissue Shrinkage**

At one month, tissue shrinkage on the side treated with laser assisted liposuction showed a 27% reduction from baseline where as the suction side had 25%. At three months, the side treated with the laser showed an 18% reduction and the suction side had a 13% reduction from baseline. The subject achieved 38% better tissue shrinkage on the laser assisted side vs. the side treated with suction alone.

**Results**

<table>
<thead>
<tr>
<th></th>
<th>One Month</th>
<th>Three Months</th>
<th>Total % Improvement on Laser Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tightening</td>
<td>Suction Only</td>
<td>With Laser</td>
<td>Suction Only</td>
</tr>
<tr>
<td></td>
<td>-33%</td>
<td>-25%</td>
<td>54%</td>
</tr>
<tr>
<td>Shrinkage</td>
<td>25%</td>
<td>27%</td>
<td>13%</td>
</tr>
</tbody>
</table>

**Subject # 2**

Subject # 2 is a 28 year old female, 129 pounds 5’ 2”, skin type III, who desired tightening and reduction of her excess adiposity of the abdominal area and tissue tightening. This subject presented with stria and lax skin resulting from weight loss. Tattoo marks were applied to measure the change in the skin and baseline elasticity measurements were taken prior to the procedure.

Patient was given 20 mg of valium and 10 mg of oxycodone as a pre-op sedative with a sip of water. After 10 minutes, standard pre-operative procedures were employed and she was taken to the operating room where a total of 1600 cc of tumescent anesthesia was administered. 5x5 cm squares were drawn with a surgical marker covering the entire treatment area. The abdomen was divided into two bilateral sections. The left side of the abdomen was treated using Smartlipo Multiplex™ and the right side was treated with sham treatment.
On the left side of the abdomen, laser assisted liposuction was performed with laser energy administered to the deep fat tissue using the Smartlipo Multiplex™ settings of 20 W of 1064 nm and 10 watts of 1320 nm wavelengths. A total of 24,000 Joules was delivered in the deep fat until the tissue became pliable at which time the deep lasing stopped. The laser fiber was then brought closer to the surface (between 2 and 5 mm under the surface of the skin) where the aiming beam was clearly visible. Superficial lasing was performed using 8 W of 1064 nm and 8 watts of 1320 nm wavelengths. A total of 22,948 pulses were delivered subdermally. The superficial lasing stopped when the skin temperature reached the clinical endpoint of approximately 42 degrees Celsius. The thermal camera monitoring for this patient measured an average temperature rise of 43.6 Celsius.

On the right side of the abdomen, the treatment was performed using the same size cannula as the laser treatment in the deep and subdermal fat. The mechanical disruption of fat was performed for the same period of time lasing was performed. The adipose tissue was aspirated from both sides. A total of 900 cc of aspirate was removed from the entire abdomen treatment area representing equal amounts from both sides.

The subject returned for 1 week, 1 month and 3 month follow up visits. The subject tolerated the procedure well with no reported adverse events and achieved marked improvement on both the tissue shrinkage and tissue tightening on the side treated with the laser as compared to the side treated with liposuction alone. The surface areas of tattoos were compared to evaluate the difference in tissue shrinkage between the areas treated with laser vs. the area that was treated with suction alone.

**Tissue Tightening**

The area was measured to evaluate the change in tissue tightening. Tissue tightening improvement was below baseline at one month for both treated sides. However, at three months, this subject showed 67% improvement in tightening on the side treated with laser assisted liposuction as compared to -20% on the non laser side. This represented an improvement on the laser assisted liposuction side of 87% compared to liposuction alone.

**Tissue Shrinkage**

At one month, tissue shrinkage on the side treated with laser had a 19% reduction vs. baseline where as the suction side had a 6% reduction. At three months, there was 9% reduction on the laser assisted side from baseline compared to 2% reduction in skin surface area on the non laser treated side. This subject achieved 350% % better tissue shrinkage at three months with the side treated with laser assisted liposuction vs. liposuction alone.

<table>
<thead>
<tr>
<th></th>
<th>One Month</th>
<th>Three Months</th>
<th>Total % Improvement On Laser Side</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tightening</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suction Only</td>
<td>-7%</td>
<td>-20%</td>
<td>-33%</td>
</tr>
<tr>
<td>With Laser</td>
<td>-40%</td>
<td>-67%</td>
<td>-87%</td>
</tr>
<tr>
<td><strong>Shrinkage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suction Only</td>
<td>6%</td>
<td>2%</td>
<td>13%</td>
</tr>
<tr>
<td>With Laser</td>
<td>19%</td>
<td>9%</td>
<td>7%</td>
</tr>
</tbody>
</table>

**Discussion:**

The Smartlipo MPX combines both the 1320nm and 1064nm wavelengths in Multiplex mode, which are highly absorbed by both adipose tissue and water. Clinical outcomes have been published for both laser assisted lipolysis and liposuction. However, this is the first study that compares laser assisted lipolysis with liposuction alone based on quantitative measurement of the effects on skin.

The two cases highlighted represent a sampling of the a larger study performed on ten patients. In this study all subjects achieved marked improvement in tissue tightening as well as improvement in tissue elasticity. To eliminate the possibility that tissue shrinkage and tightening were caused by mechanical damage only, the side not receiving laser, was treated with the cannula alone both subdermally as well as in deep fat. The manual treatment was performed for approximately the same amount of time as the laser. The side treated by mechanical damage alone did not equate to the improvement achieve on the side treated with laser.
Subjects achieved greater improvement in tissue shrinkage on the laser side as compared to the side that received liposuction alone. This was seen at both one and three months. It was noted that both edema and weight fluctuation between one and three months can effect results.

**Conclusion:**

In this study, the sides treated with the combined energy of the multiplexed laser showed a marked improvement in both tissue tightening and tissue shrinkage as compared to mechanical damage and liposuction alone. With the growing popularity of laser lipolysis it is important that the overall health of the treated tissue is well studied and understood. Based on this study, it is clear that Smartlipo MPX is able to produce both desired effects of improvements in tissue tightening and tissue elasticity. The Smartlipo MPX showed significantly greater tissue tightening and tissue shrinkage as compared to liposuction alone.

### References


5. Dang, Y; Ren, Q; Liu, H; Zhang, J; Comparison of Histologic, Biochemical and Mechanical Properties of Murine Skin Treated with the 1064nm and 1320nm Nd:YAG lasers. *Experimental Dermology* 2005 14:876-882
Our Clinical Experience

During the past several years, our typical patient is a woman in her 50s or 60s who, under normal circumstances, would be an ideal candidate for a facelift. However, the first words out of her mouth are, “Anything but a facelift.” This trend began with the advent of fillers and Botox and was quickly followed by the popularity of minimally invasive surgery.

Our patients’ complaints most often are with their neck and jowl area. Younger patients with a reasonable amount of fat will do well with standard liposuction. With age, however, the problem is more one of skin laxity, with some fullness over the jowl area. From our experience we knew that patients with a large degree of skin laxity will not respond to anything but a facelift.

Therefore, our practice spent a year experimenting with a variety of procedures, including noninvasive radio-frequency skin tightening, which achieved only minimal results and left patients unsatisfied. Then, two years ago, we began using the Cynosure Smartlipo™ laser lipolysis workstation on the neck and jowl area.

The Smartlipo laser provides aesthetic surgeons with a less invasive technique than conventional liposuction for fat reduction and body toning. Because the laser is designed to achieve tissue tightening through tissue coagulation, it is ideal for treating localized fat deposits on the face and body, and can easily treat challenging areas of high vascularity and flaccidity.

A year ago we were one of the first practices to obtain the Smartlipo MPX™, which combines the benefits of the 1064 nm and 1320 nm wavelengths with MultiPlex technology. Smartlipo MPX also takes advantage of SmartSense, an intelligent handpiece delivery system that distributes energy for more uniform results.

After using this laser in conjunction with liposuction to treat some very difficult neck and jowl patients, we changed our protocol. Suddenly, patients we would never consider for liposuction of the neck became very good candidates.

With the Smartlipo MPX laser, we are now able to address the challenge presented by skin laxity. It has allowed us to extend the indications for “minimally invasive” surgery in the neck and jowl area and can be performed under local anesthesia, resulting in less operating time, less expense and quicker recovery.

Several patients who needed extensive lift operations, but refused open surgery, were willing to try the benefits of Smartlipo MPX laser-assisted lipolysis. The following patient histories and photographs are typical of the results we have achieved using Smartlipo MPX technology. In every case, the patients were willing to try this minimally invasive procedure because they would not have to undergo open surgery. Our patients have been extremely pleased with the substantial improvement they have experienced.

We often “package” minimal facial procedures for several of our patients. Such procedures as fat injection, chin augmentation, full-face TCA peel, CO2 laser resurfacing of the lower lids, along with the Smartlipo MPX laser-assisted lipolysis and traditional liposuction of the neck, resulted in dramatic overall improvement.
We have successfully treated a dozen face-and-neck patients who would have needed a facelift—or a very extensive facelift—but who came to us for help, as long as it was not a traditional invasive facelift procedure.

In each case, we discussed the options with the patient and offered them Smartlipo MPX laser-assisted lipolysis with or without traditional liposuction. We informed them of the limits of the results we might achieve compared to open surgery. We also emphasized that we would not recommend standard liposuction of the neck and jowl area alone, knowing from experience that the results would be poor.

Preliminary results of treating with the Smartlipo MPX laser were so dramatic that we have continued to extend treatment opportunities for this laser.

The Smartlipo MPX laser produces a degree of tissue tightening through tissue coagulation that could not be obtained otherwise, even with a facelift. As indicated in several of the photographs and the angularity of the patients’ necks, accomplishing similar results with an open-lift would have been very difficult.

The following case studies will focus on patient selection, treatment technique and outcomes on the neck and jowls using the Smartlipo MPX laser.

**Methods and Techniques**

The treatment area was typically divided into 3 to 4 sections: the midline area below the chin to the neck line may be divided into 1 to 2 sections; while the left and right lateral areas are divided into individual segments. The central area was accessed through a midline incision just below the chin, and the two lateral areas were accessed via an incision just below the ear. The marginal mandibular branch of the facial nerve was avoided to prevent adverse effects associated with heat or trauma to the region. As with other procedures, when traumatizing the nerve, weakness may occur at the corner of the mouth that can take weeks to months to resolve. Thus far however, we have observed no permanent damage.

Tumescence anesthesia was applied (see additional information within each case study). The laser beam was guided through the fat by a 600-micron optical fiber within a 1 mm diameter microcannula, which was attached to the SmartSense handpiece. The optic fiber was extended 2 mm to 3 mm beyond the microcannula tip, and energy from the laser was limited to this site. Transillumination of a red helium:neon (He:Ne) beam allowed the surgeon to identify the subcutaneous location of the laser tip. The laser was set at 24 watts (W), Blend 1. This allowed rapid delivery of laser energy and resulted in a quick temperature rise in the area. It is recommended that lower power be used (8 W-12 W in total) and gradually increased until more experience is obtained with the procedure.

The laser was applied to each quadrant until the surgeon achieved the desired clinical endpoint. The surgeon’s endpoints were clinically determined and also guided by temperature rise, as measured on the surface of the skin. The clinical endpoints were the evaluation of the tissue and a safe target surface temperature of approximately 40°-42°C. The surface skin temperature was measured using an external handheld temperature recording device.

Laser energy was applied by placing the microcannula directly under the dermis where the aiming beam could be visualized through the skin to achieve the best possible tissue tightening results through tissue coagulation. In difficult cases of extremely lax skin, a second pass was made, either after the liposuction or once the area had sufficiently cooled.

Postoperative care included the wearing of an ace bandage for 3 days, 24 hours per day; thereafter 11 days when sleeping and at home, in order to reduce edema and bruising. Patient follow up was done at 24 hours for some patients, but typically at one week, one, two and three months.
Case Study #1

Patient History
A 66-year-old female was a candidate for extensive face- and neck-lift surgery with a probable outcome of less than the desired result due to an obtuse neck line and the quality of her skin. She was interested in the Smartlipo MPX laser-assisted lipolysis treatment because it could be performed under local anesthesia with minimal down time. Her medical history includes asthma and high blood pressure. She is prescribed baby aspirin, Lasix, KCL and inhalers.

Preparation and Marking
She was orally given 5 mg of Valium and 0.2 mg of Clonidine. She received 150 cc of tumescent anesthesia (0.9% normal saline with 1% Xylocaine with epinephrine) administered to the treatment area. The procedure was performed under conscious sedation administered by an anesthesiologist. The treatment area was divided into four sections (See figure 2).

Treatment Protocols
The Smartlipo MPX laser was used to treat the area, followed by liposuction to the neck and jowls. The Smartlipo MPX laser was set to Blend 1, 24 W for the entire treatment area, which was divided into four sections. The laser energy was delivered subdermally, moving the cannula in a fanning motion, ensuring even distribution of energy, until and reaching the clinical endpoint of approximately 40°C - 42°C. Liposuction was performed following the lipolysis procedure until skin tissue clinical endpoint of pliable tissue was determined. Approximately 50 cc of total volume was aspirated.

<table>
<thead>
<tr>
<th>Segment Treated</th>
<th>Baseline Skin Surface Temperature</th>
<th>Ending Skin Surface Temperature</th>
<th>Joules Delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck</td>
<td>30°C</td>
<td>42°C</td>
<td>8032 J</td>
</tr>
<tr>
<td>Right Jowl</td>
<td>30°C</td>
<td>42°C</td>
<td>1403 J</td>
</tr>
<tr>
<td>Left Jowl</td>
<td>30°C</td>
<td>42°C</td>
<td>1243 J</td>
</tr>
<tr>
<td>Sub-mandibular</td>
<td>33°C</td>
<td>42°C</td>
<td>1581 J</td>
</tr>
</tbody>
</table>

Conclusions
Postoperative care included the wearing of an ace bandage for 3 days, 24 hours per day and thereafter for 11 days when sleeping and at home, in order to reduce edema and bruising. The procedure was well tolerated with minimal discomfort, and the patient experienced minimal swelling which resolved with in a few weeks.
Case Study #2

Patient History

The patient is a 52-year-old woman who presented with several unique problems. She underwent gastric bypass surgery and had lost 125 pounds. Her request was for improvement in the neck where there was a significant amount of loose skin and a small amount of fat. I would typically suggest a facelift or at the very minimum, a neck-lift operation. Due to time and financial constraints she was unable to do this. We offered her the option of treatment with the Smartlipo MPX laser, which was used along with a minimal amount of liposuction.

Her medical history includes thyroid issues, high blood pressure and depression, all for which she is currently undergoing treatment. She is also on self-prescribed aspirin, which was stopped one week before the procedure.

Preparation and Marking

The patient was orally given 5 mg of Valium and 0.2 mg of Clonidine. She received 190 cc of tumescent anesthesia (0.9% normal saline with 1% Xylocaine with epinephrine) administered to the treatment area. The neck was divided into four treatment sections (see figure 2).

Treatment Protocols

The procedure involved Smartlipo MPX laser lipolysis, followed by liposuction to the neck and jowls under conscious sedation. The Smartlipo MPX laser was set to Blend 2, 24 W for the entire treatment.

The surface skin temperature was measured during the laser lipolysis treatment and stopped when reaching a surface skin temperature of 36°C to 40°C.

Conclusions

The patient experienced minor to no post-procedure discomfort. An ace bandage was used post procedure to minimize swelling and bruising. She had a quick recovery was in a social situation within 72 hours. She was married about three weeks after the procedure.
Case Study #3

Patient History
A 64-year-old female requested improvement in the lower portion of the face, specifically her jowls and neck. Her medical history includes asthma, depression and cold sores. She currently takes Zoloft daily.

This patient was a good candidate for the Smartlipo MPX procedure because she did not want extensive surgery and because of the skin laxity she exhibited. We knew we could not achieve the same results with liposuction. The Smartlipo MPX procedure would be key in achieving the results she wanted.

Preparation and Marking
The patient was treated with the Smartlipo MPX laser under local anesthesia with for tissue tightening through coagulation. In total, 100 cc of tumescent anesthesia (0.9% normal saline with 2% Xylocaine with epinephrine) was administered to the treatment area, and one 10 mg Valium tablet was taken orally.

The neck and jowl were divided into four treatment areas: right neck, right jowl, left jowl, and left neck.

Treatment Protocols
The laser energy was delivered subdermally, moving the cannula in a fanning motion, ensuring even distribution of energy until reaching the clinical endpoint of approximately 40°C to 42°C. The Smartlipo MPX treatment parameter for all areas was Blend 1, at 24 W.

Conclusions
The postoperative course was uneventful, and an ace bandage was worn per our standard protocol. The patient was extremely satisfied with the results.

<table>
<thead>
<tr>
<th>Segment Treated</th>
<th>Baseline Skin Surface Temperature</th>
<th>Ending Skin Surface Temperature</th>
<th>Joules Delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Neck</td>
<td>30°C</td>
<td>40°C</td>
<td>4091 J</td>
</tr>
<tr>
<td>Right Jowl</td>
<td>31°C</td>
<td>39°C</td>
<td>4088 J</td>
</tr>
<tr>
<td>Left Jowl</td>
<td>31°C</td>
<td>40°C</td>
<td>1831 J</td>
</tr>
<tr>
<td>Left neck</td>
<td>31°C</td>
<td>40°C</td>
<td>2716 J</td>
</tr>
</tbody>
</table>

Baseline photo

Figure 3

64-year-old female, local anesthesia, no aspiration, 2 months post treatment
Case Study #4

Patient History
A 61-year-old female came in for a consultation regarding her face and neck. The patient was already scheduled for a facelift at another facility. We felt a face and neck as heavy as hers would require at minimum an extensive facelift and liposuction. Under normal circumstances we would not consider doing liposuction on a neck this heavy without doing a lift as well. However, the patient had heard about the Smartlipo MPX and wanted to try the procedure, even though the potential results would be different than a traditional surgical face-and-neck lift.

Preparation and Marking
The procedure was to involve Smartlipo MPX laser-assisted lipolysis, followed by traditional liposuction to the neck and jowls, under conscious sedation.

The patient was orally given 5 mg of Valium and 0.2 mg of Clonidine. In addition, 200 cc of tumescent anesthesia (0.9% normal saline with 1% Xylocaine with epinephrine) was administered to the treatment area, which was divided into three sections (See figure 4).

Treatment Protocols
The Smartlipo MPX laser was set to Blend 1, 24 W for the entire treatment area, which was defined into three sections. The laser energy was delivered through each section, until the desired skin surface temperature was achieved.

Once the laser endpoint was reached, traditional liposuction was performed (following the laser-assisted lipolysis procedure) until skin-tissue clinical endpoint of pliable tissue was determined. Approximately 50 cc of total volume was aspirated.

<table>
<thead>
<tr>
<th>Segment Treated</th>
<th>Baseline Skin Surface Temperature</th>
<th>Ending Skin Surface Temperature</th>
<th>Joules Delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid Neck</td>
<td>30°C</td>
<td>39°C</td>
<td>1464 J</td>
</tr>
<tr>
<td>Right Jowl</td>
<td>32°C</td>
<td>41°C</td>
<td>3660 J</td>
</tr>
<tr>
<td>Left Jowl</td>
<td>29°C</td>
<td>45°C</td>
<td>4399 J</td>
</tr>
</tbody>
</table>

Conclusions
Postoperative care included the wearing of an ace bandage for 3 days, 24 hours per day, and thereafter for 11 days when sleeping and at home. Postoperative recovery was uneventful, with no unanticipated complications. The patient was very satisfied with the results.
Case Study #5

Patient History

A 45-year-old female had first been seen for a consult four years ago, requesting a facelift after losing 100 pounds by gastric bypass surgery in 2003. At that time, we felt it would be a “long run for a short gain,” as the middle of the face did remarkably well after the weight loss, and her major problem was with her neck. There was virtually no fat in the neck, and thus she was not a candidate for liposuction. We offered her a Smartlipo MPX treatment to achieve tissue tightening through tissue coagulation.

Preparation and Marking

The patient received 10 cc of tumescent anesthesia (1% Xylocaine with epinephrine) and a 10 mg Valium tablet was administered orally. The treatment area was divided into two sections (See figure 5).

Treatment Protocols

The Smartlipo MPX laser was set to Blend 1, 24 W for the entire treatment area, which was defined into two sections, and the laser energy was administered with a fanning technique until the entire section was treated. The clinical endpoint was determined by skin surface temperature.

Conclusion

Postoperative recuperation was uneventful and as per protocol an ace bandage was worn. The patient is extremely satisfied with the result and pleased that she did not undergo a facelift.

<table>
<thead>
<tr>
<th>Segment Treated</th>
<th>Baseline Skin Surface Temperature</th>
<th>Ending Skin Surface Temperature</th>
<th>Joules Delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Neck/Jowl</td>
<td>32°C</td>
<td>38°C</td>
<td>2999 J</td>
</tr>
<tr>
<td>Left Neck/ Jowl</td>
<td>31°C</td>
<td>40°C</td>
<td>1912 J</td>
</tr>
</tbody>
</table>
Case Study #6

Patient History

A 65-year-old female patient presented with skin laxity on the neck while the rest of her face looked younger than her chronological age. She requested a procedure that would allow her to return to work quickly. We felt that the Smartlipo MPX would be ideal for tissue tightening through tissue coagulation.

Preparation and Marking

The patient received 175 cc of tumescent anesthesia (1% Xylocaine with epinephrine), a 10 mg Valium tablet was administered orally. The neck was divided into four treatment sections.

Treatment Protocols

The patient received a Smartlipo MPX laser-assisted lipolysis treatment, followed by traditional liposuction to the neck and jowls under conscious sedation. The Smartlipo MPX laser was set to Blend 2, 24 W and with the treatment parameters in Figure 6.

The surface skin temperature was measured and laser lipolysis treatment was stopped when a surface skin temperature of 38°C to 40°C was reached. Due to the degree of loose skin in the neck, a second laser treatment was administered to the central neck area. This second laser dose was administered after the initial temperature subsided from 40°C to 33°C.

Conclusion

The patient tolerated the procedure very well. There was almost no bruising with the Smartlipo MPX procedure and the patient was able to return to work in a matter of days. The patient was extremely happy with the dramatic results.

<table>
<thead>
<tr>
<th>Segment Treated</th>
<th>Baseline Skin Surface Temperature</th>
<th>Ending Skin Surface Temperature</th>
<th>Joules Delivered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Neck</td>
<td>26°C</td>
<td>40°C</td>
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<tr>
<td>Right Neck/Jowl</td>
<td>28°C</td>
<td>38°C</td>
<td>4043 J</td>
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<td>Central Neck</td>
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<td>1879 J</td>
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<tr>
<td>Central Neck 2nd Pass</td>
<td>33°C</td>
<td>40°C</td>
<td>1007 J</td>
</tr>
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</table>

Baseline photo

65-year-old female, 1 week post treatment
Summary of Our Clinical Experience

As patient demand grows for minimally invasive alternatives to traditional facelifts, it becomes increasingly important to have technology to address their needs for procedures that can be performed under local anesthesia, the procedures result in less operating time, less expense and less recovery time.

With Smartlipo MPX laser-assisted lipolysis, alone or in combination with liposuction, we can extend the indications for minimally invasive surgery in the neck and jowl area. But unlike liposuction alone, we can now offer tightening through tissue coagulation as well.

The Smartlipo MPX laser has proven successful on more than a dozen patients to date, including: a patient in her mid-forties with side effects of weight loss after gastric bypass surgery; a patient in her late sixties with a thickened neck; and a patient in her mid-sixties requesting facial improvement without surgical facelift intervention. Our patients were consistent in their praise and approval of their treatment and results.

The laser’s consistent distribution of thermal energy, the blending of two wavelengths and the unique delivery system result in effective lipolysis and tissue tightening through tissue coagulation, with less surgical trauma and faster recovery.
White Paper
The Significance of Shallow Thermal Effects from a 1064nm/1320nm Laser on Collagenous Fibrous Septae and Reticular Dermis: Implications for Remodeling and Tissue Tightening through Coagulation

Gordon H. Sasaki, MD, FACS
Clinical Professor | Loma Linda Medical University Center Private Practice | Pasadena, CA

Introduction
Currently, internal laser-assisted lipolysis (iLAL) represents an evolving innovative technique that enhances the results over standard liposuction by providing selective thermo-lipolysis and thermo-denaturation of structural proteins in collagen-containing fibrous septae and reticular dermis. Of the two effects, the singular advantage of iLAL resides its ability to deliver sufficient and controlled thermal energy in a dose-response manner for collagen denaturation (water), collagenesis, remodeling and promotion of tissue tightening through coagulation. To date there have been no objective studies that quantify the relationship of lower dermal temperatures to surface skin temperatures that results in measurable shrinkage of tissue areas. This limited clinical study attempts to correlate changes in abdominal skin contraction achieved as a consequence of laser heating from a 1064nm/1320nm device during each phase of the procedure to delineate what contribution, if any, each heated layer provides to skin contraction. The objective observations were correlated to histological findings.

Smartlipo MPX™ System
The Smartlipo MPX laser workstation (Cynosure, Inc., Westford, MA, USA) emits 1064nm and 1320nm Nd:YAG wavelengths from a 600µm fiber, protruding 2mm from the tip of a microcannula. In this study, the emission of these two wavelengths was blended either in Multiplex™ Blend 3 (20watts 1064nm:10watts 1320nm) for deeper bulk lipolysis 10-30mm below the dermis or in Multiplex™ Blend 1 (10watts 1064nm: 10watts 1320nm) for shallow heating of collagen fibers (water) within the lower reticular dermis and septae. The 1064nm wavelength possesses a 3-5 times greater absorption profile for methemoglobin than for hemoglobin (higher probability of vessel coagulation), has less affinity to water, but exhibits a relatively greater depth of penetration and more diffuse distribution of energy than the 1320nm wavelength. In contrast, the 1320nm wavelength results in a higher absorption profile in fat and collagen (water) with significantly more localized and concentrated heating than that observed by the 1064 nm wavelength. When these two wavelengths are blended, an augmentation of both profiles was observed than that measured from each alone.

To better control and distribute thermal injury within the deeper fatty tissue and shallower subdermal layer, the Smartlipo MPX for this study incorporated three sensing devices:
1. An accelerometer delivery system (SmartSense™) was inserted into the handpiece as a motion sensing device to prevent excessive thermal deposition by regulating energy deliverance based on a feedback microchip technology. When the handpiece was motionless, the laser system discontinued within 0.2 seconds to avoid focal overheating.
Study Design

A randomized, controlled study measured skin tightening (contraction) in 3 nulliparous volunteers with localized lower abdominal adiposity and minimal-moderate skin laxity. Standardized digital photography, weight, body fat analysis (Futrex 5500, Futrex Inc., Hagerstown, MD) waist and hip circumferences were obtained at baseline, 3 months and 6 months after treatments. Skin contraction was assessed by using the Vectra 3D System (Canfield Scientific, Fairfield, NJ). The lower abdomen was marked into six target zones of 4x10cm rectangles each separated by 2x10cm partitions. The corners of each treated zone were tattooed with India ink. Software analysis identified the permanent markers around each targeted site and calculated the changes in horizontal, vertical, diagonal and perimeter baseline measurements compared to findings at 3 and 6 months (Figure 1). At the completion of the study, total abdominal liposuction was performed to achieve an aesthetic result in each patient. Informed consents were obtained with IRB and HIPPA-approved protocols.

2. A thermal sensing cannula (ThermaGuide™) continually recorded subdermal temperature fluctuations about 1 cm from its tip. Within the deep tissue (10-30mm), the ThermaGuide™ was at set at a 55°C threshold level. When temperatures exceeded 60°C, the laser stopped and resumed when the tissue temperature decreased below 55°C or when the ThermaGuide™ found cooler tissue.

3. When the sensing cannula was used in the shallow subdermal tissue (5mm below the dermis), the ThermaGuide™ was preset to record temperatures below 45°C. The achievement of 45°C at the shallow subdermal level registered a surface skin temperature between 40-42°C.

4. An infrared thermal camera (ThermaView) monitored real-time skin surface temperatures to attain levels between 40-42°C and ensure uniformity of heat distribution by orange-red coloration within the treatment site.
Surgical Procedure

Patients were offered preoperative pain medication and received oral antibiotics. Team members and the subject were protected by special eyeglasses. A 2mm incision below each zone permitted access for treatment. Each of the six 4x10cm target zones was treated randomly by one of the following assignments (Table 1).

Regardless of assigned treatment, deep and shallow subdermal temperatures, as well as surface skin temperatures, were recorded simultaneously in each panel by the ThermaGuide™ and the ThermaView camera. Immediately after treatment one of 1mm punch biopsy was obtained 5mm below the skin of each treated rectangle. After the surgical procedure was completed, each incision was approximated with a single suture. Subjects were dressed with sponge inserts and a compression garment for at least 2-3 weeks. Postoperative antibiotic and pain medications were prescribed.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100ml tumescent solution (500mg plain Lidocaine, 1mg epinephrine, 20ml of 8.4% sodium bicarbonate in 1000ml normal saline).</td>
</tr>
<tr>
<td>2</td>
<td>100ml tumescent solution + 500 passages of laser 1mm cannula at deep (1-2cm below dermis) and shallow (1-5mm below dermis) fat levels.</td>
</tr>
<tr>
<td>3</td>
<td>100ml tumescent solution + PAL*, 500 strokes in fan-shape pattern from deep to shallow fat levels, 4.0mm helixed triport 3 cannula, negative pressure below 500mm Hg, aspiration volume = 50ml.</td>
</tr>
<tr>
<td>4</td>
<td>100ml tumescent solution + Smartlipo MPX™ Blend 3 (20W 1064nm:10W 1320nm), 2000 Joules 1-2cm below dermis + PAL*, 500 strokes in fan-shape pattern from deep to shallow fat layers, 4.0mm helixed triport 3 cannula, aspiration volume = 50ml.</td>
</tr>
<tr>
<td>5</td>
<td>100ml tumescent solution + Smartlipo MPX™ Blend 1 (8W 1064nm: 8W 1320nm), 2500 Joules at 1-5mm below dermis, skin temperature 40-42°C + PAL*, 500 strokes in fan-shape pattern from deep to shallow fat layers, 4.0mm helixed triport 3 cannula, aspiration volume = 50ml.</td>
</tr>
<tr>
<td>6</td>
<td>100ml tumescent solution + Smartlipo MPX™ Blend 3 (20W 1064nm:10W 1320nm), 2000 joules, 1-2cm below dermis + PAL*, 500 strokes in fan-shape pattern from deep to shallow fat layers, 4.0mm helixed triport 3 cannula, aspiration volume = 50ml + Smartlipo MPX™ Blend 1 (8W 1064nm:8W 1320nm), 2500J at 1-5mm below dermis, skin temperatures between 39-40°C.</td>
</tr>
</tbody>
</table>

Table I. Assigned Treatment per Target Zone

*MicroAire Surgical Instruments, Inc. Charlottesville, VA, USA

RESULTS

Subdermal and Surface Skin Temperatures (Table 2)

The average oral temperature for the three subjects before surgery was recorded at 36.30°C (range 36.5-37°C). In Zones 1-3, the deep subdermal temperatures, determined by the ThermaGuide, at 10-20mm in the tumesced subcutaneous fatty tissue ranged between 30.5-31°C after their assigned treatments, and remained slightly higher than simultaneous surface skin temperature recordings between 27-28°C by the ThermaView and MiniTemp® handheld scanner. Zones 1-3 were not exposed to thermal energy. In contrast, Blend 3 treatments in Zone 4 successfully elevated temperatures in the deep fatty layers between 53-55°C, which increased skin surface temperatures minimally to 30-32°C. However, when the immediate subdermal tissue (1-5mm) is thermally challenged during Blend 1 treatments to temperatures between 45-470°C, as assigned to Zone 5, the surface skin temperatures rose to levels between 40-420°C. After by-layer treatments with Blend 3 and Blend 1, as recorded in Zone 6, the
corresponding surface temperature recordings were slightly lower (39-40°C) than those observed in Zone 5, receiving only Blend 1 treatments.

**Vectra 3D Analysis for Skin Contraction**

Table 3 summarizes the results of surface area changes within the six isolated rectangles as determined by 3-Dimensional Analysis using the Vectra 3D system over 3 months. Each targeted zone received a component of the standard treatment protocol for Smartlipo MPX™. A positive change in percentage of surface area within a tattooed treated rectangle reflected percent contraction of the target site over its baseline value. In contrast, a negative percent value in the surface area indicated a larger area after treatment compared to its baseline measurement. Outcomes were tested for significance with a paired t test, using p<0.05 as the cutoff value.

At the 3 month evaluation period, fifteen of eighteen targeted zones demonstrated either no change or a reduction in surface areas. Although these values ranged from 0% up to 13%, the maximum amount of contraction occurred predominantly within Zone 5 with an average of 9.1% from shallow thermal subdermal injury producing skin surface temperatures between 40-42°C after Blend 1 treatments (p<0.05). Zone 6, which received both deep (Blend 3) and shallow (Blend 1) heating, resulted in the second highest amount of average area contraction (7.5%). Since no dermal heating occurred from treatments such as tumescent solution, cannulation, pulse-assisted lipolysis and deep lasing, these maneuvers were not expected to result in any statistically significant skin contraction over their baseline values. Three of the eighteen treated zones demonstrated an increase in their areas (negative values) that could not be accounted for by the demographic weight fluctuations in these subjects at the three month evaluation period. At the 6 month evaluation period, Zone 5 (7.6%) continued to exhibit the highest average amount of surface area contraction (p<0.05) over all other zones, whose average surface area contraction ranged between a -1.0% (expansion) to 4.0% (contraction).

<table>
<thead>
<tr>
<th>Patient</th>
<th>Zone 1 Tumsc.</th>
<th>Zone 2 Tumsc. + Cannulation</th>
<th>Zone 3 Tumsc + PAL</th>
<th>Zone 4 Tumsc + Smartlipo MPX Blend 3 + PAL</th>
<th>Zone 5 Tumsc + Smartlipo MPX Blend 1 + PAL</th>
<th>Zone 6 Tumsc. + Smartlipo MPX Blend 3 + PAL + Blend 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>T₀ 31°C</td>
<td>30.5°C</td>
<td>31°C</td>
<td>53 °C</td>
<td>47 ºC</td>
<td>54 °C</td>
</tr>
<tr>
<td></td>
<td>Tₛ 27°C</td>
<td>27°C</td>
<td>28 °C</td>
<td>32 ºC</td>
<td>42 ºC</td>
<td>40 °C</td>
</tr>
<tr>
<td>2</td>
<td>T₀ 32°C</td>
<td>31.5°C</td>
<td>30 °C</td>
<td>55 °C</td>
<td>46 ºC</td>
<td>54 °C</td>
</tr>
<tr>
<td></td>
<td>Tₛ 27°C</td>
<td>27°C</td>
<td>28 °C</td>
<td>33 °C</td>
<td>41 ºC</td>
<td>39 °C</td>
</tr>
<tr>
<td>3</td>
<td>T₀ 29°C</td>
<td>29.5°C</td>
<td>29 °C</td>
<td>53 °C</td>
<td>45 ºC</td>
<td>53 °C</td>
</tr>
<tr>
<td></td>
<td>Tₛ 26°C</td>
<td>26.5°C</td>
<td>27 °C</td>
<td>30 °C</td>
<td>40 ºC</td>
<td>39 °C</td>
</tr>
</tbody>
</table>

Table 2 Deep and Surface Skin Temperatures During Phases of Treatment

T₀ = Deep Temperature  Tₛ = Shallow Temperature
Histology
The punch biopsies from the bases of Zones 1, 2, 3 and 4 demonstrated an absence of thermal changes to the collagen fibers in the lower reticular dermis and septae. The microscopic examinations of tissues below the skin of Zones 5 and 6, however, revealed marked denaturation of collagen both in the reticular dermis and septal architecture, as shown in Figure 2.

Discussion
This study demonstrates for the first time the direct relationship between precisely treated tissues and tissue contraction. The delivery of sufficient thermal energy within the shallow (1-5mm) subdermal tissue at 45°C produces surface skin temperatures between 40-42°C, that lead to denaturation of collagen fibers within the dermis and septae. Progressive skin shrinkage at 3 and 6 months follow up were observed when these conditions existed. It is of interest that an identical average amount of skin contraction (3.6%) was observed after “Liposuction only” and “Deep MPX Lipolysis and Liposuction”. Since both treatments result in volumetric fat reduction without denaturation of collagen fibers, skin shrinkage may reflect skin accommodation and retraction rather than active contraction. As anticipated, tumescent infiltration and cannulation had minimal effects on tissue contraction since no thermal injury or volume loss occurred.

Conclusion
An extramural volumetric assessment by Vectra 3D analyses observed skin shrinkage at 3 and 6 months only under conditions when sufficient thermal injury of 45°C was delivered within the immediate subdermis, resulting in surface temperatures between 40-42°C. At these precise thermal ranges, microscopic findings corroborated the clinical and Vectra 3D measurements. When treatments did not result in volume reductions within the subcutaneous fat or did not elicit enough thermal injury to septae and dermal collagen, minimal skin contraction was measured. Further studies are needed to validate these early findings.
References
Private Practice, Pasadena, CA. Clinical Professor, Department of Plastic Surgery, Loma Linda University School of Medicine, Loma Linda, CA.

Acknowledgement
The author wishes to thank Dennis DaSilva, Canfield Scientific, Fairfield, NJ for Vectra 3D Analysis and Margaret Gaston for statistics and computer assistance.

Conflict of Interest Statement
Dr. Sasaki is a consultant for MicroAire Surgical Instruments and received limited funding under an unrestricted research grant for the Vectra 3D measurements/analysis by Canfield Scientific and histological studies.
White Paper

Evaluation of Wavelengths and Wavelength Blends Employed in Laser-Assisted Lipolysis Using the Smartlipo Triplex™ Workstation

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New Jersey Plastic Surgery, Montclair, NJ

In 2006 the United States Food and Drug Administration cleared Smartlipo™ (Cynosure, Inc., Westford, MA), an Nd:YAG laser, for use in laser-assisted lipolysis and soft tissue coagulation. While not a total replacement for tumescent liposuction, laser-assisted lipolysis benefits patients looking to reduce fat and to achieve tissue tightening through tissue coagulation. Numerous studies have demonstrated that treatments with the Smartlipo laser afford patients less blood loss, shorter recovery time and decreased pain and discomfort in the post recovery period1.

Since the introduction of the Smartlipo laser, Cynosure has continued to develop laser-assisted lipolysis technology in an effort to improve patient outcomes and safety. In 2008 Cynosure introduced the Smartlipo MPX™ laser workstation, with additional power and the option of blending 1064 nm with another wavelength: 1320nm. The blended effects of the 1064nm and 1320nm combination have been documented in clinical research as providing a faster, safer and more effective delivery of energy2. More recent studies have also demonstrated tightening of tissue through coagulation when the Smartlipo MPX is used. Figure 1 depicts results from a recent study which demonstrated 57% greater tissue tightening through tissue coagulation when the Smartlipo MPX laser was used3.

In 2009 Cynosure released larger 1000 µm fibers and a new thermal sensing technology, ThermaGuide™. These provide the treating physician with the ability to accurately determine treatment doses likely to provide a secure method for laser-assisted lipolysis and more reliable ablation and coagulation of soft tissue, producing tissue tightening. Studies have determined the appropriate tissue temperature limits through correlation of temperature rise to changes in histology4. When combined with knowledge from these studies and the temperature sensing ThermaGuide technology, Smartlipo now easily provides guidance for precise and even energy application. Smartlipo systems also easily avoid excessive heating of the skin’s surface and the deep tissue structures. The ThermaGuide technology and the larger 1000 µm fibers were both used for this study.

Most recently Cynosure introduced a third wavelength, 1440 nm, to the Smartlipo platform. With this addition, the new Smartlipo TriPlex allows for even more proficient disruption of adipose tissue. The 1440 nm...
wavelength’s high level of absorption by adipose tissue creates a greater photomechanical effect so the laser effortlessly disrupts the fatty tissue, requiring less energy than other wavelengths. Refer to Figure 2 for the absorption coefficients of each wavelength in human adipose (fatty) tissue.

The 1440 nm wavelength achieves 20 times more absorption in adipose tissue than the 1320 nm wavelength and 40 times more absorption than continuous diode lasers such as 924 nm and 975 nm. These higher absorption levels translate into a photomechanical effect. The photomechanical effects are caused by the concentrated power density at the tip of the laser fiber, which creates pressure-filled micro-bubbles. The fat cells are broken up mechanically as well as thermally when these micro-bubbles disperse, causing a popping sound, also described as the “popcorn effect.”

Since the 1440 nm wavelength has a smaller, more intense zone of ablation, it allows for more specific targeting of just the fatty tissue for more efficient aspiration—and leaves any remaining tissue intact for improved patient recovery. Figure 3 depicts histologies of zones of ablation in tissue treated with one cannula pass. Note the larger zone of ablation and less collateral damage to the tissue when 1440 nm wavelength is used.

**Methods**

The 1064nm, 1320nm and 1440nm wavelengths were applied with ThermaGuide thermal sensing technology and 1000 µm fibers when evaluated for this clinical study. The goal of this study was to determine the ideal parameters and wavelength blends for typical laser-assisted lipolysis treatments. Ten treatment areas on two different patients were tested using different wavelengths and power settings. Parameters for each treatment area are provided in Table 1, “Treatment Parameters and Energy Application.” Additional details describing individual patient treatment are provided in the following two case studies.

**Figure 2**


**Figure 3**

**Histologies:** 1440nm vs. 1320nm
Subject #1

A 53-year-old white female with a BMI of 25.4 kg/m² requested the Smartlipo procedure to reduce the unwanted fat in her abdomen. She was interested in having the procedure under local anesthesia with a quick recovery period. Pre-op, complete blood count, chemistry and coagulation studies were performed and were normal. A β-Hcg was negative.

The operative area was marked and measured into sixteen 5 x 5 cm sectors, totaling 400 cm² and covering her lower abdomen (Figure 4). The patient was given 20 mg of Valium and 10 mg of Vicodin with a sip of water. After waiting 10 minutes, the patient was prepped with Betadine and placed on an operating room table draped in a sterile fashion. The treatment area was pre-injected with 60 cc of 1% lidocaine with epinephrine with a 22 g spinal needle. Using an infusion cannula, the final stage of anesthesia was accomplished in the area with 1 liter of tumescent solution (1 liter of Lactated Ringers, 50 cc 1% lidocaine and 1 cc of epinephrine 1:100,000, 12 cc of 8.4% sodium bicarbonate).

The Smartlipo TriPlex laser-assisted lipolysis system was used for the procedure employing a 2.1 mm cannula with the ThermaGuide temperature sensor. The ThermaGuide system is capable of directly measuring the temperature of the tissue surrounding the cannula. The ThermaGuide limits were set to a desired temperature and when the tissue reached the temperature, the laser automatically stopped until the cannula was moved to an untreated area. This added safety mechanism acts as a regulator to ensure consistent heating of the tissue within the desired temperature range.

The procedure began by threading the 1000 μm laser fiber, extending it 2 mm beyond the tip of the ThermaGuide cannula, and introducing it through a 2 mm incision created by a #11 blade. The right and left sides of the abdomen were to receive different treatments to evaluate the 1440-nm wavelength as compared to the 1320-nm/1064-nm wavelengths. The upper portion (an additional 50 cm²) of each side of the abdomen only received the superficial treatment. Refer to Figure 4 for a depiction of the areas treated.
The Smartlipo TriPlex laser was set to deliver 15 W of 1440 nm at a rate of 25 Hz to treat the deep layer of a 150 cm² area. The procedure was performed by moving the cannula in a fanning motion throughout the treatment area. A total of 8,800 joules were delivered to the deep fat layer until the clinical endpoint was achieved by physician judgment of pliable tissue.

The other half of the abdomen was treated with a combination of 1064-nm and 1320-nm wavelengths. The deep layer of a 150 cm² area received a total of 46 W, 16 W of 1320 nm and 30 W of 1064 nm at a rate of 25 Hz. A total of 27,600 joules were delivered to achieve the same level of tissue pliability as with the 1440 nm wavelength, as judged by the physician.

The treatment of superficial tissue was conducted by positioning the cannula subdermally. On the side treated with the 1440-nm wavelength, the same unit was reset to deliver a total of 15 W, 5 W of 1440 nm and 10 W of 1064 nm. In a similar fanning motion, almost scraping the undersurface of the dermis, a total of approximately 10,300 joules was delivered until the clinical endpoint was reached, as determined by a surface temperature of about 42 °C, as registered by the ThermaGuide system. Feedback from the ThermaGuide system enabled uniform treatment of the area while maintaining consistent temperature.

To treat the 1064-nm/1320-nm side, the unit was reset to deliver a total of 16 W, 8 W of 1064 nm and 8 W of 1320 nm. In a similar fanning motion, almost scraping the undersurface of the dermis, a total of approximately 9,200 joules was delivered until the clinical endpoint was reached, as determined by a surface temperature of approximately 42 °C, as regulated by the ThermaGuide delivery system.

Liposuction of the treatment area was performed using a 3.0 mm tri-port cannula. A volume of 260 cc of fat was removed from the 1064-nm/1440-nm side. A volume of 330 cc of fat was removed from the 1064-nm/1320-nm side. The incisions were closed with a single 6-0 Prolene stitch. Post-operatively, a piece of Topifoam was placed over the treatment area and the patient was placed in a compression garment, which was worn continuously for 72 hours, removed so she could shower, and then donned again for the balance of the week. After one week, the tapes and sutures were removed and the patient was encouraged to wear the garment whenever possible for the following three weeks.

The patient was asked to keep a journal for the first post-op week. She evaluated discomfort, bruising and swelling. She was also asked to judge her symptoms on each side of her abdomen separately. According to the diary, there was no difference in the symptoms when comparing the two sides. The patient experienced mild to moderate bruising and swelling for the first four days post-op, and only mild discomfort. Only moderate firm swelling persisted after this point which resolved by the one month follow up appointment. The patient is very happy with her results. Refer to Figure 5 for pictures of subject #1 before and after their Smartlipo TriPlex treatment.

**Subject #2**

A 60-year-old white female with a BMI of 26.4 kg/m² requested the Smartlipo procedure to reduce the unwanted fat in her upper and lower abdomen. Although she could have been a candidate for an abdominoplasty, she was not interested in having a large procedure with an extended recovery, so she opted for the Smartlipo procedure.

She could also benefit from the tissue tightening effects through coagulation that Smartlipo treatments provide. Pre-op, complete blood count, chemistries and coagulation studies were performed and were normal. The patient was postmenopausal.

The operative area was marked and measured into eighteen 5 x 5 cm sectors totaling 450 cm² covering her lower abdomen (Figure 6). The patient was given 20 mg of Valium and 10 mg of Vicodin with a sip of water. After waiting 10 minutes, the patient was prepped with Betadine and placed on an operating room table draped in a sterile fashion. The treatment area was pre-injected with 60 cc of 1% lidocaine with epinephrine with a 22 g spinal needle. Using an infusion cannula, the final stage of anes-
The anesthesia was accomplished in the area with 1.6 liters of tumescent solution (1 liter of Lactated Ringers, 50 cc 1% lidocaine and 1 cc of epinephrine 1:100,000, 12 cc of 8.4% sodium bicarbonate).

The Smartlipo TriPlex laser lipolysis unit was used for the procedure employing a 2.1 mm cannula with the Thermaguide temperature sensing delivery system. The Thermaguide system is capable of directly measuring the temperature of the tissue surrounding the cannula. The Thermaguide was set to a desired temperature and when the tissue reached temperature, the laser automatically stopped until the cannula was moved to an untreated area. This added safety mechanism acts as a regulator to ensure consistent heating of the tissue within the desired temperature range.

The procedure began by threading the 1000 micron laser fiber, extending it 2 mm beyond the tip of the Thermaguide cannula, introducing it through a 2 mm incision created by a #11 blade. The abdomen was divided into 3 sections: the right and center section was treated with 1440-nm/1064-nm wavelengths and the left section was treated with the 1064-nm/1320-nm wavelengths.

The Smartlipo TriPlex laser was set to deliver 15 W of 1440 nm at a rate of 25 Hz to treat the deep layer of fat at approximately 20-30 cm. The procedure was performed by moving the cannula in a fanning motion throughout the treatment area. A total of 7,500 joules was delivered to the deep fat layer until the clinical endpoint was achieved by physician judgment of pliable tissue. The second 150 cm² area received 10 W of 1440 nm at a rate of 40 Hz with a total of 6,000 joules delivered.

The third section of the abdomen was treated with the 1064-nm/1320-nm wavelengths. The deep layer of a 150 cm² area received a total of 46 W, 16 W of 1320 nm and 30 W of 1064 nm at a rate of 40 Hz. A total of 22,200 joules was delivered to achieve tissue pliability endpoint, as judged by the physician.

The treatment of superficial tissue was conducted by positioning the cannula subdermally. One side was treated with 16 W of 1064-nm/1320-nm wavelengths. In a similar fanning motion, almost scraping the under-
Table 1

<table>
<thead>
<tr>
<th>TREATMENT SECTION*</th>
<th>TREATMENT DEPTH</th>
<th>WAVELENGTH(S) USED</th>
<th>POWER SETTING</th>
<th>hz</th>
<th>TOTAL JOULES PER TREATMENT AREA</th>
<th>TOTAL TIME TO APPLY ENERGY**</th>
<th>SUBJECT #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Deep</td>
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<td>15 W</td>
<td>25</td>
<td>19,100 J</td>
<td>21 min.</td>
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<tr>
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<td>40</td>
<td></td>
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<tr>
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<td>Deep</td>
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<td>36,800 J</td>
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<td>16 W</td>
<td>40</td>
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</table>

**Treatment Parameters and Energy Application:** Treatment Sections 3 was identified as the most ideal treatment option due to the speed and number of Joules applied. Treatment Section 3 was up to 50% faster. Both sections 1 and 4 used up to 60% less energy than other treatment sections.

* Each treatment section consisted of approximately 150 cm².
** Time it takes to apply energy is based on a continuous application of energy throughout the treatment area. Joules = Power (W) x Time (s).

The surface of the dermis, a total of approximately 7,100 joules were delivered until the clinical endpoint was reached, as determined by a surface temperature of about 42 °C, as regulated by the ThermaGuide system. The ThermaGuide system enabled uniform treatment of the area while maintaining consistent temperature. Energy was delivered to the superficial layer of both sides at a rate of 40 Hz.

Liposuction to the treatment area was performed using a 3.0 mm tri-port cannula. A total of 830 cc of aspirate was removed of which 750 cc was fat. The incisions were closed with 6-0 Prolene.

Post-operatively, a piece of Topifoam was placed over the treatment area and the patient was placed in a compression garment, which was worn continuously for 72 hours, removed so she could shower, and then donned again for the balance the week. After one week, the tapes and sutures were removed and the patient was encouraged to wear the garment whenever possible for the following three weeks.

Post-operatively, the patient experienced some moderate, diffuse firm edema, with no distinction among any area of her abdomen. No additional pain medication was necessary. The patient was treated with biweekly sessions of TriActive for a total of five treatments. She was very satisfied with her results. Refer to Figure 7 for pictures of Subject 2 before and after their Smartlipo TriPlex treatment.
Discussion

The Smartlipo TriPlex, offering three distinct wavelengths and the ThermaGuide intelligent delivery technology is a safer and more effective procedure for laser-assisted lipolysis and tissue tightening through coagulation. Based on the results of this initial study, the most ideal treatment combinations were used in treatment area 1, where 15 W of 1440 nm alone was used to treat the deep fatty tissue and 16 W of 1064 nm/1320 nm or 1064 nm/1440 nm was used to treat superficially for tissue tightening through coagulation. Due to the greater efficiency of the 1440 nm wavelength, treatment time of this section ranged was up to 50% faster than any other treatment areas. The total energy delivered to the tissue to reach an endpoint of resistance in treatment areas 1 and 4 was up to 60% less than energy delivered to all other treatment areas.

When used in the deeper fatty tissue layers, the 1440-nm wavelength has the ability to decrease treatment time. The use of the 1064 nm/1320 nm blend at 46W in the deeper tissue was fast, but since up 60% more energy was required to treat these areas when compared to 1440 nm, the use 1440 nm would be the logical choice for treatment of the deeper tissue. When less energy is delivered to the tissue, there is less chance of damaged tissue remaining, which could adversely affect the patient’s recovery and results. In the superficial layers, the use of 1440 nm and 1064 nm seemed to slow treatment down, causing a longer treatment time. When used for superficial cutaneous applications, previous laser lipolysis studies have shown both the 1064-nm and 1320-nm wavelengths have been associated with fibroblast activity and stimulation of collagen types I and III\(^{+}\). Therefore it is recommended that a combination of 1064-nm/1320-nm wavelengths are used to coagulate tissue for tissue tightening treatments.

Conclusion

Results of this initial study demonstrate that the Smartlipo TriPlex, offering three distinct wavelengths and the ThermaGuide intelligent delivery technology is a safer and more effective procedure for laser-assisted lipolysis and tissue tightening through coagulation. The combination and options available with the Smartlipo TriPlex system allow for a more precise, targeted approach to address the patient’s concerns and also provide the surgeon with a faster treatment option in fatty tissue.

REFERENCES

1 Cynosure Smartlipo Compendium contains 40 clinical references. Cynosure Part Number 921-0132-000.
White Paper

Histological Changes after 1440nm, 1320nm and 1064nm Wavelength Exposures in the Deep and Superficial Layers of Human Abdominal Tissue: Acute and Delayed Findings

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Introduction

The addition of the 1440nm wavelength to Smartlipo MPX™ 1064nm/1320nm has redefined laser-assisted lipolysis (LAL)1-3. The longer wavelength was selected because of increased and localized photothermal and photomechanical (microbubbling) effects on fatty tissue and collagen fibers (water). The 1440nm is believed to achieve twenty times more absorption in adipose tissue than the 1320nm and forty times more absorption than 924nm/980nm wavelengths4. The 1440nm wavelength optimizes the tip’s performance in hydrated adipose tissue following tumescence and near the dermis to facilitate tissue accommodation, retraction or contraction5. Currently, Smartlipo TriPlex™ is able to blend 1064nm with 1440nm to more efficiently disrupt and debulk large-scale fatty tissue.

The purpose of this study is to correlate acute and delayed histological findings in deeper and shallower subcutaneous abdominal fatty tissue at varying watts to single 1440nm wavelength, as well as to blended wavelength modalities, utilizing the 1000µm diameter laser fiber.

Study Design:

A randomized, controlled study was designed on the lower half of the abdomen in a subject who received exposures to differing laser wavelengths and joules of energy in the deeper, shallow or both planes to twelve assigned 4x4cm panels prior to her abdominoplasty (Table 1). Cynosure’s ThermaGuide intelligent delivery system was used to control and monitor temperature throughout the treatment. The subject signed an informed consent with IRB and HIPPA-approved protocols. Tissues, located in the centers of panels A, C, E, H, J and L were submitted for histological preparation in 10% formaldehyde within an hour after injury to determine acute laser effects to the reticular dermis, septae, and fatty tissue. A punch biopsy, outside the study areas, was also submitted for control histological evaluation. Six weeks later, tissue biopsies within the centers of panels B, D, F, G, I, and K were similarly submitted for histological preparation in 10% formaldehyde immediately prior to her abdominal procedure for delayed tissue responses to laser exposures. An assigned pathologist determined the final histological interpretations of tissue injury by hematoxylin and eosin staining without knowledge of the treatment protocol.
Table 1
Depiction of Smartlipo™ TriPlex™ treatment parameters used prior to subject’s abdominoplasty procedure. Treated panels included acute and delayed tissue sections treated with the 1440nm and 1064nm blended with 1320nm and 1440nm wavelengths.

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Histological Findings
Control Biopsy (4x magnification): The epidermis, dermis and dermal appendages were present in the control specimen. The thickness of the epidermis varied between 100-120μ, while the dermal depth was measured about 1500-2000μ. The normal architecture of the septal structures and fat cells were observed to a depth of about 2-3 cm. below the dermal-fat junction.
Acute Deep Injury: 1440nm 10W 2000J @ 55 °C

Figure A
There were no epidermal or dermal changes detected after acute exposure to 1440nm wavelength energy (10W, 2000J @ 55 °C) in the deeper subcutaneous fatty planes (10x magnification). Moderate necrosis and disruption of fat cells along with focal collagen denaturation within the septal structures were observed 8-10mm below the dermal-fat junction.

Acute Deep Injury: 1440nm 15W 2000J @ 55 °C

Figure C
There were no epidermal or dermal changes observed after acute exposure to 1440nm wavelength energy (15W, 2000J @ 55 °C) in the deeper subcutaneous fatty planes (10x magnification). More extensive fat cell disruption and obliteration, along with moderate collagen denaturation within septal structures and occasional thrombosis within vessels, however, were observed at 8-16mm below the dermal-fat junction.

Figure D
There were no detectible epidermal or dermal changes seen six weeks after exposure to 1440nm wavelength energy (15W, 2000 @ 55 °C) in the deeper subcutaneous fatty layers (10x magnification). Extensive necrosis to fat cells, surrounded by a mixed inflammatory cellular reaction, along with markedly thickened septal fibrosis and neocollagenesis were observed throughout the fatty tissue 5-16mm from the dermal-fat junction.

Delay Deep Injury: 1440nm 10W 2000J @ 55 °C

Figure B
There were no thermal changes within the epidermis or dermis observed six weeks after exposure to 1440nm wavelength energy (10W, 2000J @ 55 °C) in the deeper subcutaneous fatty layers (10x magnification). Moderate necrosis to the fatty tissue and denatured fibrous septae with neocollagenesis were noted up to 12mm in depth from the dermal-fat junction.

Delayed Deep Injury: 1440nm 15W 2000J @ 55 °C

Figure D
There were no detectible epidermal or dermal changes seen six weeks after exposure to 1440nm wavelength energy (15W, 2000 @ 55 °C) in the deeper subcutaneous fatty layers (10x magnification). Extensive necrosis to fat cells, surrounded by a mixed inflammatory cellular reaction, along with markedly thickened septal fibrosis and neocollagenesis were observed throughout the fatty tissue 5-16mm from the dermal-fat junction.
There were no thermal changes observed in the epidermal or dermal levels after acute deep injury with a blend of the 1440nm (7.5W) and 1064 (12.5W) wavelength energies (2000J @ 55˚C). Marked disruption of the fat cells extended between 8-16mm below the dermal-fat junction along with a moderate thermal denaturation of collagen fibers within the septal network. Focal thromboses within vessels were also seen throughout the zone of injury (10x magnification).

There were no thermal-induced changes within the epidermis or dermis six weeks after exposure to blended 1440nm 7.5W and 1064nm 12.5W (2000J @ 55˚C). Marked fibrosis and thickening were observed in the majority of septal structures within 8-16mm below the dermal-fat junction. Disrupted fat cells were observed throughout the septae that were in various stages of fibrosis and neocollagenesis. Collapsed and thrombotic vessels, inflammatory cells and siderophages were present within the thermally injured levels (10x magnification).
Figure I
There was thermal denaturation of the lower level of the reticular dermis and collagen fibers within septae after acute exposure to the blended 1064 (10W) and 1320nm (10W) wavelength energies (530J @ 40-42 °C) at 4-7mm below the dermal-fat junction (10x magnification). Moderate necrosis and disruption of fat cells were observed to the 12-20mm depth throughout the specimen immediately after deep 1440nm wavelength energy (10W, 1000J @ 55 °C).

Figure J
Confluent reorganization and neocollagenesis were observed within the lower level of the reticular dermis and septae 6 weeks after shallow injury with a blend of the 1064nm (10W) and 1320nm (10W) wavelength energies (530J @ 40-42 °C). Fat cell necrosis and focal areas of fibrosis were noted after 1440nm wavelength energy (10W, 1000J @ 55 °C) in the subcutaneous fatty tissue 10-20mm deep (10x magnification).

Figure K
There was collagen denaturation in the lower level of the reticular dermis and collagen fibers within septae after acute exposure to the blended 1064nm (10W) and 1320nm (10W) wavelength energies (370J @ 40-42 °C) (10x magnification). Marked necrosis and disruption of the fat cells were observed down to 20mm below the dermal-fat junction after immediate exposure to blended 1440nm (7.5W) and 1064nm (12.5W) wavelength energies (1000J @ 55 °C).

Figure L
Marked fibrosis and neocollagenesis were present throughout the lower level of the reticular dermis and septal architectures six weeks after 1064nm (10W) and 1320nm (10W) energy (370J @ 40-42 °C) exposure to the shallow subdermal levels (<5mm below the dermal-fat junction). Fat cell necrosis and fibrosis were observed after blending 1440nm (7.5W) and 1064nm (12.5W) wavelength energies (1000J @ 55 °C) down to 20-25mm depth (10x magnification).
Discussion

Histological responses to combinations of laser wavelengths and energies within the epidermis, dermis and subcutaneous fatty tissue have been demonstrated in this controlled limited study. The 1440nm wavelength provided photothermal and photomechanical effects on both dermal and septal collagen fibers as well as fatty tissue. This longer wavelength delivered more localized heat than the 1064nm and 1320nm wavelengths within fatty tissue and collagen fibers (H₂O) that resulted in greater fat disruption with less power. Interpretation of tissue responses after acute and delayed injury was performed in a blinded-fashion by an assigned pathologist.

As shown in Figures A and C, the usage of the 1440nm wavelength with different amounts of energy (10 Watts, 15 Watts, respectively) alone demonstrated marked necrosis and disruption of fat cells (lipolysis) in the subcutaneous tissue that eventually led to secondary healing by fibrosis and loss of adipocytes at six weeks (Figures B and C) in a dose-dependent fashion. There appeared also a dose-dependent effect on collagen denaturation and neocollagenesis when the 1440nm energy was increased from 10 to 15 watts, maintaining a deep temperature with ThermaGuide™ at 55 °C. Since the thermal injury was delivered in the deep subcutaneous fat (10-20mm from the dermal-fat junction), collagen denaturation within the lower level of the reticular dermis was not observed.

When the 1440nm wavelength energy was delivered in the shallow depth of the subdermal fatty tissue (<5mm depth), as shown in Figures E and F, the controlled thermal injury was confined to the collagen fibers in the reticular dermis and septae, as well as the fat cells in the superficial subcutaneous tissue. Since skin temperatures were elevated between 40-42 °C with 10W (830 Joules), a marked thermal response of acute collagen denaturation (Figure E) eventually led to collagen reorganization and neocollagenesis by the sixth week (Figure F). These progressive histological changes to collagen fibers within the reticular dermis and septae may contribute to enhanced tissue tightening and lipolysis over that observed with the blended 1320nm and 1064nm wavelength energies delivered at shallow depths.

When a blend of 1440nm and 1064nm wavelength energies were delivered within the deep subcutaneous fatty tissue, as shown in Figure G, moderate fat necrosis, focal vascular thrombosis and denatured collagen fibers were observed immediately after laser energy exposure that led to fibrosis and neocollagenesis by the sixth week (Figure H). The addition of the 1064nm wavelength energy, blended with the 1440nm wavelength energy, produced a greater amount of fat cell disruption, septal collagen denaturation, and focal vascular thromboses than observed with the 1440nm wavelength alone. This combined energy may augment lipolysis and neocollagenesis, leading to later improved fat reduction and tissue tightening.

When the 1440nm wavelength energy (1000J, 55 °C) was delivered in the deep subcutaneous fatty tissue (10-20mm below the dermal-fat junction), and then followed by a blend of 1064nm and 1320nm wavelength energies (530J, 40-42 °C) in the shallow subdermal tissue (<5mm depth), as shown in Panel I, acute fat necrosis and denaturation of collagen in the reticular dermis and septae were observed. The acute injury eventually led to marked neocollagenesis in the reticular dermis and septal structures the sixth week (Figure J).

When a blend of 1440nm and 1064nm wavelength energies (1000J, 55 °C) was delivered first to the deep fatty tissue, and then followed by a blend of 1064nm and 1320nm length energies (370J, 40-42 °C), marked necrosis and disruption of fatty cells with marked collagen denaturation in septal structures were observed immediately after laser exposure (Panel K). The amount of thermal injury led to a significant amount of fibrosis within the reticular dermis and septae by sixth week (Figure L). These histological changes may eventually contribute to optimal tissue tightening and fat reduction.
Conclusions

The addition of 1440nm wavelength to Smartlipo TriPlex™ adds another dimension to laser-assisted lipolysis. When a single or blended mode is used in the deeper subcutaneous or shallow subcutaneous fatty tissues, a marked thermal response can be expected within the target chromophores (fat, collagen) in the acute and recovery phases. Control of thermal energy, using ThermaGuide is critical to obtaining an optimal clinical outcome in both fat lipolysis and tissue tightening through coagulation.

References


Acknowledgement

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Conflict of Interest Statement

Dr. Sasaki is a consultant for Cynosure and received limited funding under an unrestricted research grant for the study and histological studies.
White Paper

An Evaluation of the Subdermal use of an 1064nm Nd:YAG Laser for facial rejuvenation, both as a stand alone procedure and in conjunction with rhytidectomy procedures

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Introduction
Since being cleared in October 2006 for laser-assisted lipolysis in the United States, numerous advances have been made in the use of the Smartlipo® 1064nm wavelength Nd:YAG laser, (Cynosure®, Inc., Westford, MA). The 1064nm wavelength laser heats and disrupts a broad area of adipose tissue, aids in hemostasis of blood vessels and tightens tissue through coagulation. These properties of the 1064nm wavelength laser have been documented in more than twenty peer reviewed publications.

Most importantly, for the purposes of this study, Smartlipo has been reported to reduce tissue area by 18% and to improve skin elasticity by more than 26% when compared to untreated skin.

The tissue tightening properties of the 1064 nm wavelength Nd:YAG laser are being used for facial rejuvenation, also known as LaserFacialSculpting™ or SmartLook™ procedures. The Smartlipo laser energy can be applied underneath the skin where laser energy more effectively heats the subdermal layer to coagulate collagen. It can also be used in combination with various face-lift surgery techniques to produce the desired aesthetic outcome.

Background
Facial aging has multiple causes. Our genetic structure, which we have no control over and cannot yet change—is arguably the most important. Aging occurs in two primary ways that are especially noticeable in the facial areas: gravitational pull and soft tissue wasting (also called deflation). These affect the skin and underlying supporting structures of the face and neck. Gravitational forces provide a continual downward pull, resulting in the lengthening of the deep Superficial Musculoskeletal Aponeurotic Structure (SMAS) network that attaches to the facial skeletal structure. The overlying skin is unable to resist such force. It is a dynamic and continually renewing organ of the body. It therefore grows to cover the continually stretching SMAS underneath. Similarly, deflation occurs in all the soft tissue structures of the face due to musculature atrophy and the loss of tensile strength in the SMAS. In addition, the skin, including the subcutaneous fat and dermis, thins. The resulting lack of support for the epidermis creates new lines, wrinkles, and skin folds—all signs of aging.

To counteract the gravitational effects of aging, numerous lifting techniques have been designed over the decades. All have the same desired outcome of lifting the supporting structures of the face and re-anchoring them to the skeletal structures of the skull. The next step in almost all techniques involves the removal of extra skin that resulted from the lift procedure and subsequent skin incision closure. Some deep folds are removed and heavy
lines softened. However aged skin, although less loose and better draped on the surface of the SMAS after a procedure, is still thin, poorly toned and sallow in appearance. It looks dull and lacks the youthful glow created by reflection of ambient light on the skin. The fine, crepe-like rhytids are primarily unchanged, because, although stretched and redirected, the skin is dynamic and will grow to its natural resting place for its age.

Surgical lifting does not stimulate any significant new collagen growth, which would counteract deflation. Traditionally some topical creams or external forces are applied directly to the skin, or numerous types of collagen or hyaluronic acid fillers are available for injection to add volume and stimulate collagen growth. The external forces for skin replenishment include external beam lasers, intense pulsed light (IPL), LED devices, and chemical solutions, such as TCA, Jessner’s, Gordon-Baker, retinoid, glycolic, lactic and other fruit acid peels. These skin replacers all attempt to affect the actively growing primary source of skin renewal: the dermis. The dermis, supplied by a vascular plexus, is the source of epidermal cushioning and support. Even dermabrasion is known to have a wounding effect that stimulates the dermal plexus and by better oxygenation, results in dermal growth stimulation. Unfortunately, all of these techniques also require a transepidermal crossing of the therapeutic agent. Therefore less total energy/material is delivered to the dermis due to dissipation of energy in the epidermis or failure of penetration of the therapeutic agent. Even worse, too much epidermal absorption of energy can then cause permanent damage, creating scar tissue and/or color change. The needed breakthrough was a means of bypassing the epidermis safely and effectively to directly deliver energy to the dermis.

Cynosure has made such a breakthrough with the development of a safe and dependable system for the subdermal delivery of laser energy. The negative effects of transepidermal delivery are eliminated. The full amount of energy is directed to the best location for skin replenishment, and therefore epidermal support is maximized. The use of the 1064 nm wavelength is ideal for this stimulation since it has a safe, broad pattern for even tissue heating. This wavelength was shown by Dang et. al.\(^3\) to stimulate collagen type III in irradiated wounds which formed the basis for the use of the laser for skin enhancement of the face and neck. Two techniques were designed: (1) a standalone subdermal laser procedure for the face and neck called LaserFacialSculpting or SmartLook; and (2) an application of subdermal laser energy as an adjunct to facelifting techniques to create previously unobtainable and safe facial skin rejuvenation—without damaging the dermal plexus.

**Methods**

Four candidates were evaluated from consultations in a private facial plastic surgery practice. The candidates were divided into two groups. Two desired facial skin tone rejuvenation without any direct surgical lifting, and two desired the combination of surgical lifting and facial skin rejuvenation.

All patients had a medical clearance and appropriate preoperative labs and were consented for the procedures discussed. Oral antibiotic prophylaxis was prescribed to begin the day prior to surgery. The patients had IV sedation with full monitoring by an anesthesiologist. (These procedures may also be comfortably performed with oral sedatives such as valium; the use of IV sedation is by patient preference.)

![Figure 1 Treatment Zones with power settings and incision sites used for LaserFacialSculpting.](image)
Surgical sites were marked. Refer to Figure 1 for a diagram of areas treated with the laser. The patients were prepped and draped for sterile surgical technique. Protective eyewear was in place. The 1064 nm Smartlipo laser was used with a 600 micron fiber. The fiber was extended 2-3 mm past the tip of the 150 mm length cannula to prevent heating of the metal cannula. (This also allows easy visibility of the He:Ne aiming beam, as it transilluminates through the skin during the procedure.) Power was set at 10 watts for use along the neck and lower face regions, but reduced to 8 watts for the skin in the perioral regions. Frequency was set at 40 Hz. External skin temperature was continuously monitored using an infrared handheld thermometer. A skin surface temperature of 39°C, maximum of 40°C was targeted because tissue studies have documented thermal injury of the epidermis at 47°C. The tip of the laser was placed in the high subcutaneous plane. External skin temperature measures on average 5°C lower than the deep tissues and there is also lag time in heat diffusion upward in the skin for thermal monitoring. These temperature parameters allow for consistent energy delivery and also for safety in the prevention of epidermal lysis.

Entry sites for the laser cannula and the skin incisions for the facelift were localized with 1% Lidocaine with 1:100,000 epinephrine. Tumescent anesthesia was then infiltrated throughout the laser/surgical sites with an 18 gauge bullet-tip spray infiltration cannula in the subcutaneous plane. Laser cannula entry sites were placed in the preauricular hair tuft, anterior ear lobule groove, and the postauricular hairline at the level of the external auditory canal. For the upper perioral region an additional entry site was made in the nasal alar groove and one additional neck site within the submental crease. The 150 mm laser cannula was then passed in the subcutaneous plane, and with a steady rhythmic hand motion passed anteriorly. The regions to be treated were broken into 5x5 cm² zones and lasing was begun. Skin temperature was externally monitored with an infrared handheld thermometer. A tray of cold saline was kept at table side for immediate skin cooling if needed. As each zone reached the target temperature, the adjacent zone was entered. (Zones previously treated were rechecked as skin temperature may continue to rise slightly posttreatment)

The cannula was placed at the dermis/sub-Q layer junction, so as to not lose fat volume and fullness in the facial form. If liposuction of the submental fat pad is necessary, the substance of the fat pad should be treated following the last step.

Attention should be paid to the location of cannula to prevent the overheating of the nerves. Anatomically, the facial nerve enters muscle groups from the inferior surface, so by maintaining a high level of lasing at the dermis/sub Q junction, you will not reach the nerve itself. Monitoring of the temperature profile and maintaining the cannula at a consistent appropriate depth at all times will help ensure that the nerves stay well below the laser cannula. Special attention should be paid to treatment around the bony prominence. Laser temperature rises faster around this area and it is important to maintain parallel fiber placement subdermally.

With the LaserFacialSculpting patients, when the last zone was completed, the face was inspected for any adverse signs and then Bacitracin ointment and 4x4 gauze pads were placed on the entry sites. The face was gently wrapped with one four-inch elastic bandage with the instruction to leave it in place overnight only. Showering was allowed in twenty-four hours and ice packs were recommended for the first three to four days. Normal activity, except heavy lifting, bending, or strenuous exercise, could resume in twenty-four hours.

The group continuing with facelifts then had liposuction performed as needed. The subcutaneous dissection for flap creation was easier after the LaserFacialSculpting, as pretunneling by the Smartlipo laser had occurred. In addition the dissection-related bleeding is generally reduced due to the photocoagulative effect of the laser on the subcutaneous vessels, while the dermal plexus is preserved. It is this characteristic of the Smartlipo 1064 nm laser that makes it safe in the course of facelift surgery. A hybrid SMAS/PlatysmaMultivector facelift, designed by the author, was performed along with submental platysmaplasty. A 3-0 BioElast suture was used to anchor the SMAS/Platysma deep structures. Skin excess was resected and the skin flaps stabilized with 5-0 Vicryl subcutaneous sutures, and the skin edges were approximated with 5-0 Fast Gut sutures. No drains were necessary. The patient’s skin was then cleansed. Bacitracin was applied to the suture line, and a compressive head dressing was placed. The patient was to return in twenty-four to thirty-six hours for dressing removal and wound inspection.
Results

All subjects tolerated their procedures well. None showed signs of skin burns, infection, hematoma, or nerve weakness throughout the recovery/healing period.

LaserFacialSculpting Alone

**Subject 1:** Forty years old, with no prior facial plastic surgery history. She is of Russian heritage, a non-smoker, and a social alcohol drinker. Results show significant improvement in the definition of the jawline. Her midface soft tissue is elevated with a softening of the nasolabial fold. She displays tissue tightening (through tissue coagulation) and improved ambient light reflex. Refer to Figure 2 for pre- and postop pictures.

**Subject 2:** Fifty-eight years old and had a facelift performed five years previously. She is of Irish heritage with past tobacco use and current social alcohol drinking. Results show substantial improvement in the definition of the jawline. Her midface soft tissue is elevated with a softening of the nasolabial fold. She displays tissue tightening (through tissue coagulation) and improved ambient light reflex. Refer to Figure 3 for pre- and postop pictures.

LaserFacialSculpting Combined with Facelift

**Subject 3:** Fifty-eight years old and had a face lift four years prior with less than expected results. She is a Belize native, a nonsmoker, who has a history of daily alcohol use and heavy sun exposure. Results show overall improvement in facial/neck contours. Improvement in depth of nasolabial fold and genioglossal groove (although some adjuvant filler has been recommended). Her midface soft tissue height is elevated. Her skin dyschromia is less severe, with improved ambient light reflex. She displays tissue tightening (through tissue coagulation). Refer to Figure 4 for pre- and postop pictures.

**Subject 4:** Fifty-five years old, with no prior history of facial plastic surgery. She is of English heritage, a nonsmoker with a social alcohol history. A necklift was also performed. Results show overall improvement in face/neck contours, as well as improvement in nasolabial fold and genioglossal groove. Her midface soft tissue height is elevated, and she displays improved ambient light reflex and skin tone. Her Lower eyelid skin is more toned and nasojugal groove is partially filled. Her perioral fine lines are improved. Refer to Figure 5 for pre- and postop pictures.
Figure 3 LaserFacialSculpting Before and After Treatment

Figure 4 LaserFacialSculpting Plus Facelift Before and After Treatment
Discussion

Various and numerous surgery techniques have been postulated in the advancement of facial rejuvenation in recent years. Deep plane, superficial plane, SMASectomy, SMAS plication/imbrication, FAME lift, long flap, short flap, “S” lift, “J” lift, and the multiple trademarked facelifts on the market are all technical changes meant to achieve superior results. These have been technique driven advancements. The use of a Smartlipo 1064 nm laser to safely deliver subdermal thermal energy is a major technological advance that we believe has created the next generation of improvement in facial plastic surgery results. This manner of collagen synthesis stimulation and reorganization has not been possible previously. The results of improved facial skin tone and elasticity combined with tissue shrinkage through coagulation we feel are truly revolutionary in the facial plastic surgery field.

Approximately forty-five subjects have been treated by the author since January 2009. To date, no negative effects have occurred and all subjects still show significant improvement. (Maximum observation time exceeds one year as of this writing.) Treatments have been performed on multiple skin types, including subjects of Caucasian, Black, Hispanic, Middle Eastern, Scandinavian, Eastern European, and Asian heritage. No hyper- or hypopigmentation has developed or any sign of keloid formation. In actuality, if the subjects had areas of melasma, actinic-induced dyspigmentation or rosacea, objective visible improvements were noted in most all cases.

Postoperative bruising was generally mild in the laser-alone subjects and reduced in the lift/laser subjects, when compared to average facelift-alone patients. Pain was reported as mild to none. The subjects having surgical lifting concurrently had noticeably less utilization of pain medication than the usual facelift-alone patients. This reduced utilization of pain meds has been reported concerning Smartlipo LaserBodySculpting™ compared to same site-standard body liposculpting (personal communication with Gordon Sasaki, M.D., Pasadena, CA).

Observed changes in the skin of the treatment population are many. Pore size was reduced. The improved skin’s ambient-light reflex results in a more youthful, glowing complexion. Tissue shrinkage through tissue coagulation provides a gentle lifting effect on the treatment zones, whether surgical lifting was performed or not. Treatment zones can include all areas of the face and neck, excluding the nose and eyelid skin. Results are minimally evident in as little as two weeks. (Prior to the introduction of the laser, normal edema makes it difficult to notice any
improvement.) The first three months post procedure are when the majority of skin changes are seen, with mild further improvement noted up to six months later. Improvement is then stable. The maximum post operative observation is one year to date. All patients reported being overall very satisfied with their results. This was recorded in questionnaires on pending studies, as well as in reduced pain medication requirements. As with any rejuvenation technique, the longevity of the results will be affected by all the same aging factors that were present at the time of the procedure.

It is important to constantly measure skin surface temperature during this procedure. Advanced instrumentation such as the ThermaGuide™ (Cynosure Inc., Westford, MA), an internal temperature monitoring cannula, aid the surgeon by providing accurate internal soft tissue temperature readings as lasing occurs. In addition, ThermaView™ (Cynosure Inc., Westford, MA), a thermal imaging camera which integrates with the laser, can also be beneficial by showing temperature over a large field on a video screen. As noted in prior studies, soft tissue thermal denaturation occurs at +45°C. The maximum facial skin surface temperature should not exceed 40°C. The temperature at 5 mm subdermal is about 5°C higher than the skin temperature. As heat rises, the skin temperature will continue to increase after the cessation of lasing. This is why it is important to recheck the most recently lased zone even after moving to a new treatment site. Any skin temperature recorded above 40°C should be immediately cooled with saline soaked sponges to prevent injury.

All techniques using the Smartlipo 1064 nm Laser for Facial Rejuvenation are of an advanced nature. They should only be performed with a thorough knowledge of laser physics and soft tissue interaction. The surgical techniques should not be attempted without advanced training in facelift and laser surgery. As patient demand for maximum cosmetic results with minimally invasive procedures and rapid recovery times continues to grow, this new surgical technique of a well documented technology will have a central place in aesthetic plastic surgery practices.

References

6 Collawn SS. “Skin tightening with fractional lasers, radiofrequency and Smartlipo,” Aesthetics of Plastic Surgery Volume 64, Number 5, May 2010.
White Paper

Present And Future Use Of A Subdermal Nd:YAG Laser On The Face

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Introduction

In recent years, lasers have been adapted for treating localized fat. Years ago the use of this method was restricted to non-facial areas. However, increased knowledge about laser and tissue interactions, as well as the possibility of obtaining not only fat-cell disruption but also tissue tightening, supports the efficacy and safety of subdermal laser-assisted facial treatments. Recent publications demonstrating the use of the laser in direct contact with targets like the submental fat and dermis layers opened up new applications on different areas of the face—both as an isolated procedure or in combination with traditional approaches, non-surgical options and surgeries.

Liposuction has become increasingly popular over the last decade and is now among the most popular procedures. Its popularity is associated with the evolution of techniques and equipment for fat removal, body and face reshaping, and tissue shrinkage through tissue coagulation. The search for alternative treatments and new tools was driven by the desire to reduce patient downtime, decrease surgical effort, reduce bleeding and scarring, promote skin tightening, and facilitate treatment of fibrous regions and secondary cases. Laser lipolysis is currently very popular and the use of the laser on the face is an excellent treatment for aging, including for the improvement of facial and neck contours.

This paper demonstrates the experience of the author during the last ten years in the use of the subdermal Nd:YAG laser on the face, as well as to suggest possible new uses of this exciting technology.

Preparation

After the patient is briefed on the treatment to follow, he or she signs the consent form and is photographed. All procedures are made under aseptic conditions. (Note: the exact technique depends upon the condition(s) being treated. However, these steps represent a general treatment guide and demonstrate the current approach of the senior author.) Usually no sedation is necessary. In selected cases when the laser will be used in conjunction with a major procedure such as a facelift, sedation or even general anesthesia can be used.

The areas to be treated are marked and a lidocaine with epinephrine solution is injected. The solution varies according to each surgeon and tumescent klein solution anesthesia can also be used. At this time, according to the particular condition and the surgeon’s preference, external cooling systems or cold compresses can be applied to the treatment area in order to decrease the possibility of epidermal injury. The procedure is then initiated after a fifteen minute delay, allowing for adequate anesthesia and appropriate vasoconstriction.

Nd:YAG Laser Protocols

One or more entry incisions are made using an 18 g needle or an 11 blade. After adequate eye protection is donned, the laser is used subdermally (Smartlipo Cynosure, USA). The exact parameters vary according to both the machine (one, two or more wavelengths) and the condition being treated. The Nd:YAG laser is used in the subcutaneous fat tissue and subdermis...
through an optical fiber, which is delivered through a very small 1-2 mm-diameter cannula. The laser energy is applied in the sub-cutaneous tissue as well as in the subdermal layer if it is indicated.

A digital external thermometer can be used during the laser treatment in order to evaluate the external skin temperature. To avoid epidermal burning, a temperature limit of about 40 degrees Celsius must be observed. Handpieces controlling the speed, energy delivery and tissue temperature such as SmartSense™ and ThermaGuide™ were recently incorporated into Cynosure systems and represent important advances in safety and efficacy.

Facial treatments usually do not require any suction. In selected cases the product of the cellular lysis is removed using negative pressure of around 350-450 mmHg, in conjunction with a 2.5 mm or 3 mm suction cannula (more than 40-50 ml of treated fat tissue, for example in the submental area).

No oral antibiotic is used. Antibiotic cream is applied to the small incision(s). No dressing is needed. Acetaminophen or another analgesic is recommended or prescribed. External lymphatic drainage is initiated in the first day post-op.

Primary Applications of the Subdermal Nd:YAG Smartlipo Laser on the Face

Submental Region

The first and most frequent indication of the subdermal laser on the face is the use in the submental region and jawline. The first article published in Lasers in Surgery and Medicine in 2006 demonstrated not only the technical aspects and results, but also the histological changes resulting from the use of the subdermal Nd:YAG laser. These histological findings and their clinical significance form the basis of the understanding and use of this technique in all medical conditions. Consequently, it is also important to remember the other significant results following laser lipolysis: the coagulation of small blood vessels in the fatty tissue, the rupture of adipocytes (tumefaction and lysis), the appearance of small channels or tunnels produced by the laser treatment, the reorganization of the reticular dermis, and the coagulation of collagen in the fat tissue. These factors may be responsible for the observed tissue retraction following the procedure. In patients suffering from axillary hyperhidrosis, a histological examination of the sweat glands treated with the Nd:YAG laser showed microvesiculation, decapitation and dilatation of the eccrine glands after laser treatment.
The histological findings and post-operative clinical outcomes of subjects who underwent laser lipolysis of the submental area, neck, and jowl have proven the safety and effectiveness of laser lipolysis using an Nd:YAG laser. Figure 1 demonstrates a result of Smartlipo submental treatment.

**The Laser in Combination with Rhytidectomy and Other Procedures**

The subdermal laser can be effectively used in combination with traditional surgical approaches. The main goal in using a laser in combination with a facelift, neck surgery or an SMAS plicature treatment is to build small tunnels in the tissue, thus providing better mobilization of the facial flaps and decreasing the detached area. This combination decreases the trauma to the area. The lipolysis effect associated with the small channels in the subcutaneous tissue and the coagulation of small blood vessels both facilitate the safer detachment of the flaps.

In addition, all these advantages are likely associated with less patient downtime. And this less traumatic alternative for face and neck rejuvenation probably decreases the incidence of side effects such as epitheliolysis, necrosis, infection or nerve injury. The surgical procedure is based on the local effects of the Smartlipo Nd:YAG laser (photomechanical and photothermal) facilitating the subcutaneous soft tissue dissection between the flap and deeper structures on the face. The tightening effect*, plays an important role in this combination in improving the facial contour and redefining the mandibular border and submental area. Figure 2 demonstrates a result using the subdermal Smartlipo on the face in combination with a facelift and SMAS plication. Observe the improvement of the wrinkles, skin texture and the tightening effect*.

The laser can be used adjunctively in different regions of the face, including the cervical region, forehead, periorbital, subzygomatic and other areas. It is crucial to have a complete knowledge of the facial anatomy. Prudence and conservative parameters must be observed in order to avoid complications.

**Subcutaneous Zygomatic Pad Treatment**

The subcutaneous zygomatic pad is a relatively frequent area of patient concern. This condition is associated with aging and is usually very difficult to treat using traditional surgical approaches. According to the author’s experience, these pads are a result of a small amount of localized fat, skin and subcutaneous tissue flaccidity and lymphatic edema located over the zygomatic bone. They are probably related to some alteration in the lymphatic system, anatomical changes and to the aging process itself. The photomechanical and the thermal effects of the Smartlipo treatment in the zygomatic pad produce lipolysis of fat cells and the tightening of the tissues.* This procedure is currently being investigated.
Fine Lines

Subdermal laser treatment may improve fine lines and skin texture through the new collagen formation induced by the laser. Crow’s feet and zygomatic wrinkles represent some possible areas to be improved using this new technical innovation. This technique would require further investigation.

Frey’s Syndrome

Gustatory sweating on the cheek, also known as Frey’s Syndrome, represents a disorientation of the parotid innervations. This condition occurs in 20-60% of patients after parotidectomy and it is related to a misdirection of autonomic nerve fibers after surgery—or even in the disease of the parotid gland. Following mastication or stimulation of salivation, excessive sweating and flushing occurs in the affected area. Traditional treatments include the creation of a prophylactic, creating a barrier between the parotid gland and the skin. The author has had excellent results in the management of Frey’s Syndrome, as well as in other hypersecretory disorders using the subdermal application of the Smartlipo Nd:YAG laser. Potential uses of this approach include craniofacial hyperhidrosis and compensatory hypersecretion on the body following sympathectomy.

Comments

Some years ago the concept of tissue expansion by using expanders revolutionized reconstructive surgery. The inverse aim, to tighten the tissues and mainly the skin, looks to be the aim of the twenty-first century. There is no doubt that the current uses of subdermal laser lipolysis will play a fundamental and promising role in this field of medicine. Approximately one decade ago, in association with Dr Blugerman and Dr. Schavelzon, the author was introduced to the current uses of the pulsed 1064 nm Nd:YAG laser in laser-assisted lipolysis. These initial presentations and publications are the foundation of the current principles and techniques using this exciting technology. Facial laser treatment and its effects have already been scientifically demonstrated. The use of this laser, both on its own and also in association with traditional surgical techniques, fillers, botulinum toxin injections, chemical peels, dermabrasion sessions—or other energies such as radio frequency, intense pulsed light, fractional laser and others—represents a current trend in plastic surgery, dermatology and aesthetic procedures. The association of new wavelengths, different types of lasers, new devices, advanced control tools, new handpieces and software, as well as the accumulated knowledge and new studies and protocols, reveal a promising future for Smartlipo technology.

Conclusions

The Smartlipo Nd:YAG laser has been demonstrated as a safer and more effective alternative option in the treatment of many facial conditions. Recent advances in this technology continually increase both its applications and its safety. The use of the Nd:YAG laser in the body and face is a relevant, useful and effective technical alternative for body contouring and facial rejuvenation. It is an excellent and scientifically proven option to meet patients’ demands for less invasive procedures and less recovery time.


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*Through tissue coagulation
Introduction

As more women and men want to look and feel better about themselves, less invasive options for facial rejuvenation continue to grow in popularity. As the demand for procedures increases and patients spend more time researching options, they are making more informed choices and many times opt for technologically advanced procedures. Utilizing a laser underneath the skin to coagulate tissue and increase collagen production can create dramatic results with less downtime than traditional rhytidectomy techniques alone.

LaserFacialSculpting provides a revolutionary and minimally invasive approach for facial rejuvenation procedures. When a high-peak-powered laser is incorporated subdermally through small incisions on the face and neck to separate tissue; simultaneous tissue contraction and tightening through coagulation is observed. The addition of the laser also increases hemostasis and tissue tightening through coagulation when compared to techniques involving cannulation only. LaserFacialSculpting techniques are associated with less downtime and side-effects due to less tissue trauma, bleeding and surgical time. This study describes an entirely new set of techniques which highlight the effects of Smartlipo™ and Smartlipo MPX (Cynosure Inc. Westford, MA) laser energy when applied subdermally with the absence of rhytidectomy techniques.

The LaserFacialSculpting technique was used in facial rejuvenation procedures for patients who desired facial and neck tightening but refused incisional techniques. LaserFacialSculpting also permits flap treatment in typically difficult to reach areas such as the nasal labial folds and the corner of the mouth. Scar tissue and prior surgeries are also more easily elevated and treated with LaserFacialSculpting because of the laser’s ability to lase through scar tissue. We also find these techniques useful in touch-up procedures after rhytidectomy and with patients who have undergone rhytidectomy in the past and do not want a subsequent incisional technique.

Methods

The LaserFacialSculpting procedure employs a 1064nm/1320nm Nd:YAG Smartlipo laser and is cleared for subcutaneous use in the U.S. This minimally invasive surgical procedure disrupts the soft tissues in the plane between the subcutaneous and the SMAS (superficial musculoaponeurotic system) or superficial fascial layers. This laser system provides short pulses and has very high peak powers. In this procedure, the laser energy is delivered to the subcutaneous tissue through a 600-micron optical fiber inserted through a 1mm diameter stainless steel microcannula of variable length. A 2mm section of the optical fiber protrudes through the distal end of the cannula. An He:Ne laser source is provided in the beam path to visualize the precise location of energy application at the tip of the fiber. The aiming beam is visible through the skin due to the trans-illumination effect.

A 100μs, 1064nm pulsed laser at 40Hz and 9W is used for the treatment of most facial and neck anatomical regions. In the treatment of small or very superficial areas, the power and/or the laser action time can be decreased.
Two effects can be observed from the laser dissection process: the thermal effect and the photo-mechanical effect. Temperature monitoring can be accomplished by either external monitoring with a hand-held infrared thermometer or with ThermaGuide™ (Cynosure Inc., Westford, MA), an integrated, internal temperature monitoring system. (Figure 1). At no time should the external temperatures exceed 42 degrees Celsius or epidermal necrosis may occur. A facial grid is used to guide the application of laser energy to the facial and neck soft tissues (Figure 2 A,B). LaserFacialSculpting™ allows for the coagulation of small blood vessels in the subcutaneous plane with preservation of the dermal plexus of vessels. Tissue tightening through coagulation also occurs concurrently with the tissue separation.

Study Design and Technique:

A retrospective review of five LaserFacialSculpting procedures was completed to evaluate the effectiveness of sculpting the facial and neck region with the Smartlipo laser. The patients were predominantly female and were generally healthy and between the ages of 46 and 60. Patients were treated with local anesthesia supplemented with mild or moderate intravenous sedation. Routine laboratory testing was completed as appropriate for the level of anesthesia given and patient medical history. The procedures were carried out in a state-licensed, nationally accredited ambulatory surgical center specializing in facial and aesthetic plastic surgery. Patients were photographed prior to the surgery for comparative purposes. Early post-operative photos were taken at two to three weeks and will be completed at two months, three months and one year. The LaserFacialSculpting procedures were generally performed in patients who did not yet require rhytidectomy or who refused incisional techniques. All patients were treated with the same uniform application of Smartlipo laser energy as measured by thermal end points and administered to the grids depicted in Figure 2 A, B.

LaserFacialSculpting procedures were performed after subcutaneous infiltration of a tumescent solution containing normal saline, epinephrine and Sodium Bicarbonate. The total volume of the infiltration varied, but averaged 60-75cc per facial side, with lateral neck included - and the same amount for the anterior neck.

The procedure was initiated after 5-10 minutes, to allow for diffusion of the anesthesia and appropriate vasoconstriction. A warm fluid infiltration is recommended to avoid the pain produced by the difference in temperature between the fat tissue and the infiltration fluid. All procedures were performed using local anesthesia with mild sedation. As noted, the patients in this study were provided mild to moderate IV sedation. Oral sedation can also be used to supplement the anesthetic.

A 1mm incision was sufficient to introduce the Smartlipo cannula; seven incisions were used for each LaserFacialSculpting procedure. The locations of the incisions are depicted in Figure 2 A, B. The laser was not activated while introducing it into the incision to avoid damage of the skin. The Smartlipo laser energy was applied subdermally to the midline neck first, followed by the right face and lateral neck and then the left face and lateral neck. More distal blocks were treated prior to more proximal blocks.

The earliest LaserFacialSculpting procedures were performed until the cannula passed easily through the soft tissues without meeting resistance. This method was then replaced by thermal endpoints after it was determined that the best way to achieve effective tissue tightening (through tissue coagulation) would be to maximally heat the facial segments to a safe temperature that would not induce epidermal necrosis. Earlier studies with Smartlipo techniques completed by DIBernardo indicated that epidermoly-
sis occurs at temperature between 47 and 52 degrees Celsius and that externally measured temperatures have about a 5 degree variance from actual temperatures at the laser’s position beneath the skin. This provides an actual safe temperature of 42 to 47 degrees Celsius as the ceiling for treatment, which can be controlled using the ThermaGuide system.

At the end of the Smartlipo laser treatment, aspiration was performed on every patient. The amount of aspiration performed was determined by the relative fat content of the facial and neck areas treated. Heavier faces and necks were treated more vigorously and thin necks were only mildly aspirated.

**Results and Observations:**

**PATIENT 1: UTILIZING 9W OF 1064NM ND:YAG LASER ENERGY**

A 41-year-old female patient was interested in a procedure to tone her skin’s appearance and to also improve laxity. She was not interested in incisional techniques for facial rejuvenation and had little time off for recovery.

**Procedures**: LaserFacialSculpting of the face and neck. Skin resurfacing with a micro-ablative CO₂ laser (face only).

**Postoperative Results**: There was improvement in the visibility of the mandibular contour. There was improved tightening of facial soft tissues through coagulation and improved facial shape and contour. There was reduction in depth of nasal-labial and melo-labial folds.

**PATIENT 2: UTILIZING 9W OF 1064NM ND:YAG LASER ENERGY**

A 52-year-old female patient was interested in a procedure to tighten her jowls and neck. She refused any incisional techniques due to her full time job with limited time off for recovery.

**Procedures**: LaserFacialSculpting of the face and neck. Chin augmentation. Skin resurfacing with a micro-ablative CO₂ laser (face only).

**Postoperative Results**: There was improvement in the visibility of the mandibular contour. There was improved tightening of facial soft tissues through coagulation and improved facial shape and contour. There was a reduction in overall facial volume and the jowl area as well. There was a lengthening of the face, which is more aesthetically pleasing.

**PATIENT 3: UTILIZING 9W OF 1064NM ND:YAG LASER ENERGY**

A 52-year-old female patient was interested in a rejuvenation procedure to tone and tighten her facial and neck skin. She was unhappy when she saw herself in photographs taken from the side due to the significant laxity in her jowls and neck.

**Procedures**: LaserFacialSculpting of the face and neck. Chin augmentation. Skin resurfacing with a micro-ablative CO₂ laser (face only).

**Postoperative Results**: There was improvement in the visibility of the mandibular contour. There was increased tightening of facial soft tissues through coagulation and improved facial shape and contour. There was a reduction in volume of the jowl.

Patient 1 is shown before and 10 weeks after LaserFacialSculpting of face and neck

Patient 2 is shown before and 10 weeks after LaserFacialSculpting of face and neck

Patient 3 is shown before and 10 weeks after LaserFacialSculpting of face and neck
**PATIENT 4: UTILIZING 9W MULTIPLEXED 1064/1320NM ND:YAG**

A 50-year-old female patient was interested in a procedure to tighten her jowls and especially the “waddle” in her neck. She was not interested in incisional techniques due to her full time job with limited time off for recovery.

**Procedures:** LaserFacialSculpting of the face and neck. Skin resurfacing with a micro-ablative CO$_2$ laser (face only).

![Patient 4 is shown before and 10 weeks after LaserFacialSculpting of face and neck](image)

**Postoperative Results:** There was improvement in the visibility of the mandibular contour. There was improved tightening of facial soft tissues through coagulation and improved facial shape and contour. A marked and unexpected nearly total correction of laxity in her neck was observed.

**Discussion and Conclusion**

Tissue tightening has previously been performed with transcutaneous application of an energy source using laser or radiofrequency devices. Subdermal or subcutaneous energy application was not possible until the approval of the Smartlipo 1064nm Nd:YAG laser. The era of sub-cutaneous aesthetic laser surgery began with the introduction of the Smartlipo laser in 2006 which has many positive attributes. As we have previously described in our observations with Smartlifting, the laser functions remarkably as a hemostatic device. We have performed over 400 laser-assisted lipolysis procedures of the head and neck with minimal complications. In the course of patient consultations, we began to realize that facial sculpting procedures may be an excellent recommendation for patients with mild facial laxity or for those with an aversion to large facial incisions. Many patients refused any incisional techniques right from this start, which made the treatment selection easy for us. As we evaluated the results of these treatments, several observations emerged. The techniques were effective in all patients, but they were more effective in certain patients. There seem to be several patient “types” that benefit the most. For example, younger patients (40-55 years old) with a bit more fatty deposition and tissue tone will tend to show the greatest improvement with LaserFacialSculpting procedures. And the results of the procedure can be complimented by utilizing other minimally invasive techniques, particularly laser skin rejuvenation procedures or augmentation procedures, including dermal fillers.

LaserFacialSculpting procedures are now possible with the emerging technology introduced by the Smartlipo laser. In performing the procedures, there seems to be equally effective results with the 1064nm wavelength as the multiplexed 1064nm/1320nm wavelength when utilizing 9W of power.

**References:**


Introduction

A woman’s breasts often change over time, losing their youthful shape and firmness. These changes can result from pregnancy, breast feeding, weight-loss, ageing, gravity, and heredity. This can create a weakening of the dermal collagen matrix and suspensory ligaments within the breast. Loss of this extracellular collagen is responsible for loss of structural integrity and subsequent impairment of fibroblast function. Women often seek breast-lift treatments to restore the breast’s firm and youthful appearance.

Surgical breast lifts, also known as mastopexy, raise and firm the breast by removing excess skin and tightening the surrounding tissue, in order to reshape the contour of the breast and elevate the nipples to a higher position. Various surgical approaches are used, including crescent lifts, periola lifts and vertical masoplexy. Each of these surgical approaches is chosen based on the size of the breast and the degree of ptosis.

In some cases, breast implants may be inserted at the same time to give the breasts a fuller, rounded and natural appearance.

Fortunately, significant complications from breast lifting surgery are infrequent. Every year many thousands of women undergo successful breast lifts without experiencing any major problems and are pleased with the results.

However, the associated recovery time with breastlift surgery can be significant and the recovery time can last weeks, be quite painful and leave large, visible scars.

This study will discuss a new minimally invasive approach, utilizing the delivery of Nd:YAG laser energy to provide a scar-free breast lift for a specific group of patients that include Grade 1 or 2 (mild to moderate) ptosis of the breast. The results of this study showed an improvement of lift whereby the mean average was 3 cm and the range was from 2 cm to 6 cm.

The Smartlipo MPX laser (Cynosure, Westford, Mass.) was used to treat patients in this study. The Smartlipo MPX laser emits 1064 nm and 1320 nm Nd:YAG wavelengths from a 600 µm fiber, protruding 2 mm from the tip of a microcannula.

Methods & Materials

Treated were 38 women between the ages of 28 to 40 years of age were treated with a breast cup size ranging from A to C, with either mild (Grade 1) or moderate (Grade 2) ptosis of the breast and with no preexisting asymmetry. The study was conducted over a period of 15 months.

All patients had a medical clearance and appropriate preoperative labs and were consented for the procedures discussed. Oral antibiotic prophylaxis was prescribed to begin the day prior to surgery.
The treatment site (auxiliary extension of the breast) was marked pre-treatment which is on average a 5 x 5 cm area. (Refer to Figure 1). The patient was then prepped and draped for the sterile surgical technique. Entry sites for the laser cannula and the skin incisions were localized with 1% Lidocaine with 1:100,000 epinephrine. Tumescent anesthesia was then infiltrated throughout the laser/surgical sites with an 18 gauge bullet-tip spray infiltration cannula in the subcutaneous plane. One entry site of approximately 2 mm was made under the armpit for each treatment site placed under the armpit.

In this study, the Smartlipo MPX was used to emit two wavelengths and was blended either in Multiplex™ Blend 3 (20 watts 1064 nm:10 watts 1320 nm) for deeper bulk lipolysis, 10-30 mm below the dermis, or in Multiplex Blend 1 (10 watts 1064 nm: 10 watts 1320 nm) for shallow heating of collagen fibers (water) within the lower reticular dermis and septae. The laser energy was delivered through a 600 micron fiber threaded through a 2 mm cannula. The 1064 nm wavelength possesses a 3-5 three to five times greater absorption profile for methemoglobin than for hemoglobin (therefore higher probability of vessel coagulation), has less affinity to water, but exhibits a relatively greater depth of penetration and more diffuse distribution of energy than the 1320 nm wavelength. In contrast, the 1320 nm wavelength results in a higher absorption profile in fat and collagen (water) with significantly more localized and concentrated heating than that observed by the 1064 nm wavelength. When these two wavelengths are blended, an augmentation of both profiles was observed when compared to measurements that measured from each alone.

To better control and distribute thermal injury within the deeper fatty tissue and shallower subdermal layer, the Smartlipo MPX™ for this study incorporated three sensing devices:

1. An accelerometer delivery system (SmartSense™) was inserted into the handpiece as a motion sensing device in order to prevent excessive thermal deposition by regulating energy deliveryance based on a feedback microchip feedback technology. When the handpiece was motionless, the laser system discontinued within 0.2 seconds to avoid focal overheating.

2. A thermal sensing cannula (ThermaGuide™) continually recorded subdermal temperature fluctuations about 1 cm from its tip. Within the deep tissue (10-30 mm), the ThermaGuide was set at a 50°C threshold level. When temperatures exceeded 50°C, the laser stopped and resumed when the tissue temperature decreased below 50°C or when the ThermaGuide found cooler tissue. When the sensing cannula was used in the shallow subdermal tissue (5 mm below the dermis), the ThermaGuide was preset to record temperatures below 45°C. The achievement of 45°C at the shallow subdermal level registered a surface epidermal temperature of 40-42°C. Feedback from the ThermaGuide system enabled uniform treatment of the area while maintaining consistent temperature.

3. An infrared thermal device monitored real-time skin surface temperatures to attain levels of 40-42°C and ensure uniformity of heat distribution by within the treatment site.

The laser cannula was guided through the subcutis in a fanning pattern until the endpoint of reduced adipose thickness was reached. Lasering was then redirected to the subdermal area for treatment of the superficial plane of the subdermal layer.

External skin temperature was externally monitored with an infrared hand held thermometer ion addition to the use of a ThermaGuide cannula. A tray of cold saline was kept at tableside for immediate skin cooling if needed. Suction aspiration followed lasering to remove the treated adipose tissue with a 3 mm cannula.

A 2 cm length of ½ inch steri-strips™ was applied to the incision for one week and dressed with a Medpore® 6 x 7 cm absorbent dressing for two days. Showering was allowed in 24 hours and ice packs were recommended for the first one to two 1-2 days. Normal activity could resume in 24 hours with the exception of heavy lifting, bending, or strenuous exercise.

The distance between the nipple and the clavicular bone were measured in a straight vertical line at pre-op, immediate post treatment, at three weeks and three months to measure efficacy.
Results
All subjects noted improvement in the overall lift as a result of the treatment area. All subjects tolerated their procedures well. None showed signs of skin burns, infection, or hematoma throughout the recovery/healing period. Immediate post treatment measurements averaged a 1-2 cm improvement (lift) and a 2-6 cm lift at three months. A reduction in fatty tissue volume and improved skin laxity through tissue coagulation were observed in the treated area in all patients. All treated subjects would recommend the treatment to a friend or family member.

Two patients developed slight erythema and bruising for one week. No other side effects such as numbness and edema were recorded in any patients.

The detailed results of two study patients are included in the case report section of this paper.

Discussion
Previous studies have demonstrated the clinical benefits of laser energy applied within the subcutaneous tissue to various anatomic regions. Treatment areas in published studies have included the submental area, axillae sweat glands associated with hyperhidrosis, abdomen, and the fibrous tissue associated with gynecomastia. Within each of these studies, the authors note the ability of the laser energy to disrupt adipocytes, generate new collagen through tissue coagulation, and reduce downtime from hemostasis via thermal coagulation.

Now, with the understanding and clinical benefits of the delivery of thermal energy subcutaneously, the same results can be achieved within the auxiliary extension of the breast. The disruption of adipocytes and the denaturing of collagen within the subdermal area can repair the weakened dermal collagen matrix and create a remodeled framework of collagen bundles and suspensory ligaments. As discussed by Katz et al., histological findings demonstrated new collagen production specific to the interaction of the laser with the underlying tissue. Biopsy specimens demonstrate evidence of parallel bundles of collagen, which are characteristic of new collagen/wound repair. DiBernardo et al. demonstrated a 26% increase in skin elasticity through tissue coagulation and skin shrinkage through tissue coagulation of 17% at three months post operatively. Therefore treatments that stimulate production of new, non-fragmented collagen should provide substantial improvement to the treated tissue.

Skin in the auxiliary extension of the breast is thin and therefore epidermal surface temperature must be monitored and should not exceed 40-42°C. Studies by DiBernardo et al. indicate that regions of the body with thinner skin may be prone to more thermal injury from laser treatments. The combination of the author’s experience and peer reviewed studies suggest an optimal surface temperature range for both safe lipolysis and superficial tissue stimulation at or below 42°C.

Patient selection and clear expectations for the patient are important to achieve high patient satisfaction.

Conclusion
The subcutaneous delivery of blended 1064 nm and 1320 nm laser energy within the auxiliary extension of the breast results in the heating of collagen bundles and the disruption of adipocytes. The laser energy provides an ability to generate new collagen and tissue tightening through tissue coagulation and myofibroblast production, resulting in an elevation of the breast shape.

Case Reports
Patient 1
A 34-year-old patient, 134 pounds, height was 5’ 11” or cm, skin type II, bust size 32 B was treated for grade 2 (moderate) ptosis of the breast (See Figure 1).

Pre-op measurements were taken of the clavicle to the nipple. Patient was given 20 mg of diazepamvalium and 1 mg of paracetamol as a pre-op sedative, with a sip of water.

After 10 minutes, the patient was prepped and marked. Tumescent anesthesia was administered using the Klein method for a total of 600 cc for both treatment sites. On the right side of the breast, laser energy was administered to the deep fat tissue using 20 W of 1064 and 10 watts of 1320 nm wavelengths. A total of 2000 Joules was delivered in the deep fat. The laser fiber was then redirected to the surface of the skin (where the aiming beam was clearly visible) and superficial lasing was performed using 10 W of...
1064nm and 10 W of 1320nm wavelengths. The superficial lasing stopped when an epidermal surface temperature of approximately 39° C was achieved. A total of 1000 joules were delivered subdermally.

On the left side, the treatment was performed using the same parameters and joules as in the right side and performed in the deep fat and subdermally for the same period of time.

The adipose tissue was aspirated and removed from the entire treatment areas, representing equivalent amounts from each treatment site side of approximately 60 cc’s from each treatment site. The subject tolerated the procedure well.

**Results**

There were no postoperative complications. Pre-op measurements of the nipple to the clavicle were 21.4 cm on the right breast and 21.93 cm on the left breast. Measurements at 3 months were 18.40 cm on the right breast and 18.45 cm on the left breast. The right breast showed a lift of 3 cm and the left a lift of 2.68 cm, approximately 13% improvement.

**Patient 2**

A 41-year-old patient, 140 pounds, height was 5’8”, skin type II, bust size 34 C was treated for grade 2 (moderate) ptosis of the breast. Pre-op measurements were taken of the clavicle to the nipple. Patient was given 20 mg of diazepam-valium and 1 mg of paracetamol as a pre-op sedative with a sip of water.

After 10 minutes, the patient was prepped and marked. Tumescent anesthesia was administered using the Klein method for a total of approximately 600 cc for both treatment sites. On the right side of the breast, laser energy was administered to the deep fat tissue using 20 W of 1064 and 10 watts of 1320 nm wavelengths. A total of 2000 Joules was delivered in the deep fat. The laser fiber was then redirected to the surface of the skin (where the aiming beam was clearly visible) and superficial lasing was performed using 10 W of 1064 nm and 10 W of 1320 nm wavelengths. The superficial lasing stopped when a skin temperature of approximately 39° C was achieved. A total of approximately 1000 joules were delivered subdermally. On the left side, the treatment was performed using the same parameters and joules as in the right side and performed in the deep fat and subdermally for the same period of time.

The adipose tissue was aspirated and removed from the entire treatment areas, representing equivalent amounts from each treatment site side of approximately 80 cc’s from each treatment site. The subject tolerated the procedure well.

**Results**

There were no postoperative complications. Pre-op measurements of the nipple to the clavicle were 21.5 cm on the right breast and 21.03 cm on the left breast. Measurements at 3 months were 19.59 cm on the right breast and 19.19 cm on the left breast. The right breast showed a lift of 1.91 cm and the left a lift of 2.74 cm approximately 11% improvement.

**References**


Steri-strips™ are a trademark of 3M Nexcare

Medpore® is a registered trademark of Mölnlycke Health Care

FIGURE 2 Pre and post procedure

FIGURE 3 Pre and post procedure
Patient Case Report

Smartlipo® Treatment of Abdomen Area

Dr. Steven Cimerberg
Advanced Medical Spa, Plantation, FL

PATIENT HISTORY
A 41-year-old Hispanic female with Fitzpatrick skin type IV sought consultation for the treatment of excess fat in the abdomen and flanks areas. The appearance of her skin was soft and regular with excellent turgor and moderate fibrous fat zones. The patient appeared to be in great physical condition. Smartlipo was recommended as the most effective treatment due to the location of the fat areas and the need for tissue tightening through coagulation.

SEDATIVE
The patient received 1 mg of Ativan PO 30 minutes prior to the surgery.

ANESTHESIA
Local anesthesia was delivered to multiple incisions with 3 mL of 2% lidocaine and epinephrine (1:100,000 ratio). 500 mL of tumescent solution (100 mL of 1% lidocaine plain with 1 mL of epinephrine [1:1000 ratio] in 1000 mL of Lactated Ringer’s solution) was then administered subcutaneously in the areas to be treated.

LASER PROTOCOL
The areas were treated with a power of 10 watts at 40 Hz until the endpoint was reached. The endpoint was determined based on exclusion of resistance, skin temperature and skin turgor. A total energy of 9,396 joules was delivered to the abdomen and flanks.

AFTER ASPIRATION
The liquefied fat cells of the abdomen were removed with the help of a 4.0 mm Double-Mercedes tip style cannula. For the flanks, a 3.0 mm tri-port cannula with power-assisted aspiration was used. A total of 50 mL was aspirated in both treated areas, with 50% fat and 50% supernatant fluid. No sutures were used and wound was left open for drainage for a period of 2 days.

POSTOP TREATMENT
Postoperatively, the patient was instructed to wear an abdominal compression binder for 8 weeks. She was also prescribed Omnicef 300 mg tab PO BID for a total of 1 week, starting the night before the surgery.

Patient was seen one day, one week and one month for postop evaluation. The day following the surgery, the patient had no bruising, minimal swelling and mild discomfort. At the one-week follow-up visit, she was very happy. She reported losing 1 inch around her waist and fitting better in her pants. The patient was encouraged to return to normal activity with the exception of exercising for a period of 2 weeks. However, being an aerobics instructor, the patient returned to work within 2 days following the procedure.

SUGGESTIONS FOR OTHER PRACTITIONERS
Performing liposuction with Smartlipo requires both time and patience. Treated areas should be properly injected with Tumescent solution and laser energy evenly distributed. In order to maximize patient outcomes, it is also recommended to encourage patient compliance for wearing compré following postop instructions as closely as possible.
Patient Case Report

Smartlipo® Treatment of Submental Area

Dr. Cheryl Karcher, MD, MS, FAAD
New York, NY

PATIENT HISTORY
A 54-year-old female complaining of the condition of her submental area sought consultation for a minimally invasive treatment.

The patient has a Fitzpatrick skin type III presenting lipodystrophy and skin elastosis. Her BMI was 28.1. Pre-op lab-works were within normal limits including CBC, liver and SMA 20. Smartlipo was recommended for lipolysis and tissue contraction.

SEDATIVE
The night before the surgery, the patient was given 1 mg of Keflex. Prior to the surgery, she received 4 mg of Versed, 25 mg of Vistaril and 50 mg of Demerol administered intramuscular into the hip. Mid surgery, she received another 2 mg of Versed intramuscular into the arm.

ANESTHESIA
700 cc’s of tumescent fluid with 0.1% lidocaine was injected in the treated area using a blunt tip Kline infusion.

LASER PROTOCOL
The area was treated primarily superficially with a power of 6 W at 40 Hz with a total energy delivered of 3,800 joules. Three entry points were made: one under the chin and one behind each ear. The endpoint was determined based on exclusion of resistance.

ASPIRATION
A 2 mm cannula was used with a Kline power suction unit set at high. Approximately 100 cc’s of fat and 100 cc’s of fluid were removed. No sutures were used and the wound was left open for drainage. A steri-strips was applied on each entry point and an absorbent pad was placed above.

POSTOP TREATMENT
Patient was instructed to continue to use 500 mg Keflex BID for 3 days. A head and a neck compression garment were recommended for 24 hours until the postop appointment. Tylenol with codeine was prescribed if needed for pain. The patient was seen the following day of the surgery and displayed drainage via the 3 incisions, some swelling in the neck and chin, and some ecchymosis. The patient was advised to continue using the compression garment until the second follow-up visit planned two weeks after. At two weeks, the swelling and bruising were significantly reduced, leaving smooth tissue with significant reduction of lipodystrophy. The patient was very pleased with the final results.
PATIENT HISTORY
40-year-old female complaining of excess fat within her submental area and looking for minimally invasive treat-
ment. Fitzpatrick skin type VI presenting excess fat pad under chin. Patient was normal weight and all labs were within normal limits including CBC, Liver and SMA 20.

SEDATIVE
Preop administered 2 mg of Versed intramuscular into arm. Mid surgery 2 mg of Versed was administered intramuscu-
lar into arm. Patient was also given 1 g of Keflex the night before surgery.

ANESTHESIA
470 cc’s of tumescent fluid with .1% lidocaine solution with blunt tip Kline infusion.

LASER PROTOCOL
3 watts at 20 Hz treated primarily superficially with 525 joules. Endpoint was determined based on exclusion of resistance to cannular advancement. Three entry points were made, one under the chin and one behind each ear.

ASPIRATION
A 2 mm cannula was used with Kline power suction unit. The aspirator suction was set to high. Approximately 50 cc’s of fat and 50 cc’s of fluid were removed. No sutures were used. Wound was left open for drainage with an absorbent pad and steri-strips.

POSTOP TREATMENT
The patient was instructed to continue use of Keflex for three days 500 mg BID. Reston Foam chin strap was recom-
mended for twenty-four hours until postop appointment.
Tylenol with codeine was prescribed if needed for pain.
Patient was seen next day for postop appointment. Patient displayed drainage via incisions, minimal swelling, and a very slight bruising on right lateral side of neck where Reston Foam was not applied. Reston Foam is suggested for pa-
tients without solar elastosis or sun-damaged skin.
At two weeks, swelling and bruising were significantly re-
duced, fat pad was reduced. Patient was very satisfied.

Patient Case Report
Smartlipo® Treatment of Submental Area

Dr. Cheryl Karcher, MD, MS, FAAD
New York, NY

BEFORE

AFTER

BEFORE

AFTER

BEFORE

AFTER
Patient Case Report

Smartlipo® Treatment of the Oblique Abdominal Region

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INTRODUCTION

Liposuction is currently the most frequently performed aesthetic operation in the world. As the demand for body contouring procedures continues to rise, the search continues for techniques to improve results, minimize risk, optimize patient comfort, and reduce the recovery period. Recently, various laser-assisted lipolysis devices have attempted to address these concerns and improve upon the practice of lipoplasty.

Smartlipo is a pulsed 1064 Nd:YAG laser for the surgical incision, excision, vaporization, ablation, and coagulation of all soft tissues. This platform is ideal for treating localized deposits of unwanted fat, fat tissue irregularities, and for coagulating tissue leading to a tissue tightening effect. Excess flaccidity can now be targeted along with excess adiposity during the same procedure.

The device utilizes a 1mm cannula and a 300 or 600 μm laser fiber to disrupt adipocytes via delivery of thermal and photoacoustic energy. Smartlipo has a pulsewidth of 150 microseconds, a high repetition rate of 40 Hz and a maximum power output of 18 Watts. The laser makes use of a pulsed format to rupture adipocytes. The 1064 nm wavelength is scattered widely and targets hemoglobin and adipocytes. Therefore this wavelength disrupts a broad region of adipose tissue while heating the treatment areas evenly. The heat acts on the adipocyte and the extracellular matrix to produce both reversible and irreversible damage which facilitates lipoplasty by lessening trauma and bleeding via small vessel coagulation.

A study conducted at Sadick Research Group examined the use of this device in the treatment of the oblique abdominal region in 10 patients. Overall patient satisfaction was reported at 100% with 26% experiencing mild bruising. Improvement in tissue tightening among all the cases was averaged at 3.5 on a scale where 1 was minimal and 5 was maximal tightening. Exercise resumption occurred within 24
to 48 hours post procedure. On average around 10,000 J of energy were required to treat the flanks. The following case details our experience with the Smartlipo system and highlights the advantages over conventional suction lipectomy.

PATIENT HISTORY
A 33 year-old Caucasian male with excess adipose tissue in the oblique abdominal region (flanks) wished to improve his shape. He was a casual smoker, who had an inguinal hernia repair 15 years prior to this operation and was otherwise healthy. He had no previous history of liposuction to the flanks.

PREPARATION AND MARKING
Informed consent was obtained and baseline photographs were taken. Patient was marked with surgical marker and prepped and draped in standard sterile fashion. One mg of Ativan and 7.5 mg of Percocet were administered orally for mild sedation. Warm tumescent anesthesia composed of 1000 cc Lactated Ringers, 1 cc epinephrine 1/1000, 25 cc of 2% lidocaine and 10 cc 8.4% sodium bicarbonate was administered to the subcutaneous layer until the area was fully tumescent (total of 1600 cc administered).

LASER AND ASPIRATION PROTOCOL
Once properly anesthetized, a baseline temperature was obtained. Laser-lipolysis was then administered with 10 Watts of 1064 nm at 40 Hz to the deep subcutaneous tissue until the tissue was pliable and an end external temperature range between 38 and 40°C was obtained. A total of 10,000 J of energy was delivered to each flank. Laser lipolysis was then followed by traditional aspiration utilizing a 3 and 4 mm suction cannulas.

RESULTS
Patient post-op follow up times were 1 week, 1 month, 3 months, and 6 months. In the presented case, 1 week after the procedure minimal bruising, a reduction of fatty tissue, and improved tissue laxity were observed (Figure 1). At the 6 month follow up there was no evidence of discomfort, redness, bruising, swelling or tingling and tissue laxity improvement was assessed as moderate at 3.5 on a scale of 1 to 5. Post-procedure discomfort was subjectively assessed by the patient as 1 on a scale of 1 to 5, with 0 being none and 5 being severe. Resumption of all daily activities occurred within 24 hours. The patient is remarkably pleased with the results and feels that the area exposed to the laser has a smoother texture. He would recommend this procedure to family and friends.

CONCLUSIONS
Laser lipolysis performed by the Smartlipo platform has demonstrated less recovery time and less pain than traditional liposuction. This procedure allows for greater hemostasis via coagulation of small blood vessels and thus less patient bruising and faster recovery. Patients at risk for skin laxity following adipose tissue removal should be considered for Smartlipo laser-assisted lipolysis to increase tissue coagulation resulting in a tightening effect. The more gentle nature of this procedure compared to conventional lipoplasty makes it ideally suited for areas of higher vascularity.
Patient Case Report

Treatment of a Giant Lipoma using the Smartlipo®

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INTRODUCTION
Lipomas are the most common benign tumors composed of fat cells. They occur primarily in the subcutaneous tissue. Giant lipomas should be differentiated from liposarcomas, both of which have similar tumor dimensions. Surgical excision still represents the standard treatment for lipomas. However, laser assisted liposuction has been used as an option for the treatment of lipomas. This case study will discuss the treatment of a giant lipoma using laser assisted lipolysis treatment with the Smartlipo Workstation.

CASE REPORT
A 52 year old female patient was presented with a giant lipoma located on her back and arm. The lesion was surgically excised three years prior, but reoccurred and measuring 11 x 13.5cm. Based on its size and its reoccurrence after standard surgical excision, Smartlipo was chosen to subcutaneously treat the lipoma. The lipoma was photographed and measured before the treatment. Ultrasound was performed to assonate the lesion and histological evaluations were performed to assure that the lesion was benign. The lesion was marked prior to surgery and subcutaneous infiltration of 350 cc of anesthetic solution (30cc of Lidocaine 2%, 1cc of epinephrine 1:1000 and 10 milliequivalents per liter sodium bicarbonate are added to each liter of normal saline) was delivered to the treatment area. After adequate eye protection for the patient, physician and nursing team, the laser lipolysis procedure was performed. The optical fiber protruding 2-3mm from the distal extremity of the cannula was inserted through a single small incision. The Smartlipo laser was set at 10 W of power with 1064 Nd YAG when the fiber was in direct contact with the fatty tissue. The cannula was moved in three different layers, deep, medium and subdermal, allowing adequate time for effective laser-tissue interaction. A total accumulated energy of 32,100 J/cm2 was applied to the tissue. The clinical endpoint was to overcome resistance of the cannula, which indicates that lipolysis has occurred with the formation of an oily and less dense solution within the
Before, during and immediately after the treatment, an external air cooling device was applied to minimize the possibility of epidermal damage. The oily tissue was removed from the region by aspiration using a 2mm diameter cannula (two holes) and a negative pressure of 350mmHg. The aspirated material was sent for histological analysis and the diagnosis was confirmed as lipoma. The histological evaluation demonstrated fragments of fatty tissue including the focal disruption of lipocytes and destruction of membrane and cell integrity. The subject tolerated the procedure well and no adverse effects were observed. At the one year follow up, the lesion was absent, and the tissue had healed well, without the presence of a scar.

**DISCUSSION**

The main disadvantage of surgical excision of lipomas is the presence of scars. Small lipomas are usually difficult to treat with liposuction due to their small dimension. Previous studies have shown the Smartlipo’s lipolytic activity can cause coagulation of small vessels, coagulation of the reticular dermis, resulting in neocollagen formation in the subcutaneous layer and dermal tissue making laser lipolysis of lipomas a true treatment option. The effect of the laser in the capsular membrane presented in lipomas is disruption and fragmentation similar to what occurs in fatty tissue. The pulsed 1064nm Nd-YAG laser has two physical effects in the fat: a thermal effect and mechanical effect represented by the intensity of the laser beam against the membrane of the fat cell within the lipoma. By applying a multi layer treatment technique, the laser can disrupt the fatty cells (medium and deeper), and heat the dermis to promote tissue coagulation stimulating neocollagenesis and create skin tightening through subdermal treatment.

**CONCLUSION**

The advantage of using the Smartlipo for the treatment of lipomas compared to surgical techniques is that the procedure is less invasive without leaving large scars. The procedure was shown to be a safe and effective treatment for giant lipoma.
Patient Case Report

Smartlipo MPX™ Treatment of the Arms

Dr. Barry DiBernardo
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PATIENT HISTORY
A 37 year old woman with a BMI of 29.0kg/m² sought treatment to reduce skin laxity and fat in her arms. She “couldn’t find short sleeve shirts to fit her arms” and the patient indicated she was more comfortable with a less invasive procedure which only involved local anesthesia. After learning about the Smartlipo procedure, she agreed it would be the right procedure for her. A pre-op work-up included a complete blood count, chemistries and coagulation studies which were all normal. A β-Hcg was also done and was negative.

SEDATIVE
The patient was given 20 mg of Valium and 10 mg of Percocet with water.

PREPARATION AND MARKING
The operative areas were marked and measured in 5 x 5 cm sectors totaling 200 cm² for each upper arm. After waiting 10 minutes, the patient was prepped with betadine and placed on an operating room table draped in a sterile fashion.

ANESTHESIA
The treatment area was pre-injected with 60cc of 1% lidocaine with epinephrine with a 22g spinal needle. Using an infusion cannula, final stage of anesthesia was accomplished in the area with approximately 530cc of tumescent solution per arm (1 liter of Lactated Ringers, 50cc 1% lidocaine and 1cc of epinephrine 1:100,000, 12cc of 8.4% sodium bicarbonate).

SMARTLIPOMPX LASER PROTOCOL
A blend of 1064nm and 1320nm wavelengths was selected to first disrupt the deep fatty tissue and then maximize skin tightening effects through tissue coagulation. The Smartlipo MPX™ laser was set to 20W of 1064 nm and 10W at 1320 nm for the procedure. The laser fiber was threaded through a cannula and introduced through a 2mm incision created by a #11 blade. A total of 19,850 Joules was delivered to the deep fat layer of each arm using a fanning motion. The laser power was then reduced to 6W of 1064nm and 6W of 1320nm to superficially treat the skin. Through the same incision, the appropriate number of joules was delivered to each sector until the skin surface temperature reached an average of 42.5°C. The average skin surface temperature was 30.5°C just prior to treating the superficial layer. A total of 14,335 Joules were delivered superficially to each brachial region, just below the dermal layer.
ASPIRATION
Aspiration of the treatment area was performed using a 3.0mm tri-port cannula.
From each arm, a total of 500cc was removed of which 400cc's was fat and the remainder, fluid. At the conclusion of the procedure, the incisions were closed with a single 6-0 prolene suture and dressed with a steri-strip.

POST-OP TREATMENT
Post-operatively, a compression garment was placed on the arms. The hand and forearms were wrapped with ace wraps to minimize post-operative swelling. To further minimize swelling, the patient was advised to keep her arms elevated on pillows when resting. The ace wraps could be removed the following day. The arm garment was removed after 72 hours so that the patient could bathe. The patient wore the compression garment continuously for the remainder of the first week, and then whenever possible for the next four weeks.

Antibiotics were given to the patient for 1 week post-operatively. The patient stated she experienced a minimal amount of pain the first day following the procedure and no pain thereafter.

At the one week post-op visit, the sutures were removed. The patient was already able to appreciate a marked improvement in the girth of her upper arms. There was minimal swelling and no bruising at this time. The procedure was performed on a Friday and the patient was able to return to work the following Monday.

CONCLUSIONS
Smartlipo MPX™ laser assisted lipolysis was an excellent choice for the elimination of unwanted fat and improvement of skin tone for this patient. At the age of 37 her skin retained enough elasticity to respond well to the laser therapy. The Smartlipo MPX laser works by both coagulating blood vessels to minimize bruising and coagulating tissue for a tightening effect. When compared to traditional liposuction methods, a smaller aspiration cannula was used since the laser also emulsified the fat. Additionally, a smaller incision was needed and patient trauma was minimized, which all resulted in greater patient satisfaction.

At one month post-op, the patient’s arms showed dramatic improvement and the patient stated she is at last able to find shirts that fit properly.
PATIENT HISTORY
A 24 year old female with a BMI of 19.0kg/m² wanted to improve the profile of her lateral thighs. Smartlipo MPX was recommended as the most effective treatment due to the location of fat areas and the need for skin tightening. Pre-op complete blood count, chemistries and coagulation studies were performed and were normal. A β-Hcg was also done and was negative.

SEDATIVE
The patient was given 20 mg of Valium and 10 mg of Percocet with water.

PREPARATION AND MARKING
The operative area was marked and measured in 5 x 5 cm sectors totaling 200 cm² on each thigh. After waiting 10 minutes, the patient was prepped with betadine and placed on an operating room table draped in a sterile fashion.

ANESTHESIA
Each thigh was pre-injected with 25cc of 1% lidocaine with epinephrine with a 22g spinal needle. Using an infusion cannula, final stage of anesthesia was accomplished in each thigh with 785cc of tumescent solution (1 liter of Lactated Ringers, 50cc 1% lidocaine and 1cc of epinephrine 1:100,000, 12cc of 8.4% sodium bicarbonate).

SMARTLIPPO MPX LASER PROTOCOL
A blend of 1064nm and 1320nm wavelengths was selected to first disrupt the deep fatty tissue and then maximize skin tightening effects through tissue coagulation. The SmartlipoMPX™ laser was set to 20W of 1064 nm and 10W at 1320 nm for the procedure. The laser fiber threaded through a cannula was introduced through a 2mm incision created by a #11 blade. A total of 24,000 Joules were delivered to the deep fat layer of each thigh, using a fanning motion. The laser was then reduced to 8W of 1064nm and 8W of 1320nm to superficially treat the skin. Using the same incision, the appropriate number of joules we delivered to each sector until the surface temperature reached an average of 42°C. A total number of 13,750 Joules were delivered superficially to the entire treatment area, just below the dermal layer.
ASPIRATION
Power-assisted liposuction to the treatment area was performed using a 3mm cannula. Approximately 340cc was removed from each lateral thigh, of which 185cc’s was fat and the remainder, fluid. At the conclusion of the procedure all of the incisions were closed with a single 6-0 prolene suture then dressed with a steri-strip.

POST-OP TREATMENT
Post-operatively, the patient was placed in a compression garment, which was worn continuously for 72 hours, then removed so she could shower. The patient wore the compression garment continuously for the remainder of the first week, and then whenever possible for the next four weeks.

A prescription for Percocet was given to the patient for post-operative pain management, but she only used Tylenol on an occasional basis. Antibiotics were given to the patient for 1 week post-operatively. The patient stated she experienced a moderate amount of pain the first day following the procedure and no pain thereafter. The procedure was performed on a Thursday and the patient was able to return to her job the following Monday. At one week post-op the patient returned to the office, she had no specific complaints and was happy with the results thus far. There was no significant bruising or swelling and her sutures were removed at 7 days post-op.

CONCLUSIONS
At one-month post-op the patient returned for a follow-up visit and she had no complaints. She was very happy with the improvement of the contour of her thighs and noted her clothing was fitting much better. At the three-month post-op visit, the patient and doctor both noticed the improved in skin tightening through tissue coagulation. Smartlipo MPXTM laser assisted lipolysis was an excellent choice for the elimination of unwanted fat and improvement of laxity for this patient. She was interested having a procedure done under local anesthesia and tolerated it well. At the age of 24 her skin’s elasticity responded well to the laser therapy. The Smartlipo MPX laser works by both coagulating blood vessels to minimize bruising and coagulating tissue for a tightening effect. When compared to traditional liposuction methods, a smaller aspiration cannula was used since the laser also emulsified the fat. Additionally, a smaller incision was needed and patient trauma was minimized, which all resulted in greater patient satisfaction.
Patient Case Report

Subcutaneous Zygomatic Pad Treatment Using the Smartlipo® Laser

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BACKGROUND
A beautiful and young face is usually associated with prominent cheekbones and a smooth transition between the lower eyelid and the cheek. In young patients the malar fat pad is located over the zygomatic bone. This subcutaneous structure becomes ptotic with age and gravity. Anatomical changes, downward migration of some tissues, and attachment alterations related to the aging process can all modify these characteristics.

Subcutaneous zygomatic pad is a relatively frequent concern. This condition is associated with aging and is usually very difficult to treat using traditional surgical approaches. Many patients will not agree to invasive or traditional procedures, such as different types of rhytidectomy or thread suspension. According to the authors’ experience, these pads are related to a small amount of localized fat, skin, and subcutaneous tissue flaccidity—as well as lymphatic edema, probably related to some alteration in the lymphatic system, anatomical changes, and to the aging process itself.

The use and effectiveness of the Smartlipo laser has already been well documented in many scientific publications, which discuss its indication in the reduction of localized fat, as well as in the improvement of tissue tightening through coagulation. The laser’s photomechanical and the thermal effects play an important role in the changing of these prominent fat and flaccid pads, producing lipolysis and tightening of the tissues.

PATIENT HISTORY
A 53-year-old female with a bilateral subcutaneous zygomatic pad, without any previous treatment, requested a less invasive procedure to correct it. She was a non-smoking patient and with no previous clinical alterations.

PREPARATION
No sedation was necessary for the procedure, which was conducted under aseptic conditions. The areas to be treated were marked and 1.5 cc of 1% lidocaine with epinephrine was injected in each side. Saline-solution cold compresses were applied to the area. The procedure was initiated following a fifteen minute delay, allowing for adequate anesthesia and appropriate vasoconstriction.

SMARTLIPO LASER PROTOCOLS
One single entry point incision was made for each side using an 18 gauge needle. After eye protection was put on, 6W of 1064-nm Nd:YAG laser energy was delivered to the subcutaneous fat tissue and dermis through a 300-micron optical fiber, inserted through a 1 mm-diameter cannula (figure 1).

The cannula was inserted through the incision and subcutaneous tunnels were created. The laser was then moved in through the tissue in a fan-like motion. The laser energy was applied in the fatty tissue, as well as in the subdermal layer. The total accumulated energy used in each side was 2,000 J/cm².

Immediately after the laser treatment, a gentle massage was performed in the treated area, allowing for a mechanical drainage of the oily solution through the entry incision.
TEMPERATURE REGULATION
During the procedure an external air cooling system was
used over the treated region, decreasing the external
temperature and protecting the epidermis against poten-
tial thermal damage. A digital external thermometer was
also used during the laser treatment in order to evaluate
the external skin temperature. A high-temperature limit of
40°C was set as the safe endpoint for the laser treatment.

POST-OP
Immediately after the procedure a smooth cold com-
press was applied to each side for ten minutes. No suction
was needed. Antibiotic cream was applied in both small
incisions. No dressing was used, nor were oral antibiotics
prescribed. Acetaminophen was recommended, but the
patient did not take it. The post-operative period was very
well tolerated with neither pain nor discomfort. External
lymphatic drainage was initiated in the first day post-op.
Minor edema lasted two weeks. There was no ecchymosis.

RESULTS
The subcutaneous zygomatic pad was significantly re-
duced following treatment (see figure 2). No facial nerve
problems or skin damage were observed. There was no
bruising. The patient had some infraorbital edema that
required two weeks to subside. The patient was followed
for a period of one year after the subdermal laser treat-
ment. The laser was effective, not only in the reduction
of the elevated pad, but also in tightening the tissue
through tissue coagulation. Therefore, the Smartlipo
1064-nm Nd:YAG laser was demonstrated to be an ideal
alternative option in the treatment of the subcutaneous
zygomatic pad.

CONCLUSION
The aim of this approach was not only to restore the origi-
nal anatomy, but also to improve the aspect of this lower
lid bulging due to a prominent fat pad. In addition an-
other goal was to produce an effective tissue tightening
through coagulation. The subdermal treatment of subcu-
taneous zygomatic pad using the Smartlipo laser proved
to be a useful and versatile tool in the amelioration of this
condition. This indication opens the possibility to use this
internal or subdermal laser treatment in other alterations
such as hemangiomas or wrinkles.

Figure 2
*Before*: Preoperative photograph of 53-year-old patient with
mild subcutaneous zygomatic pad. *After*: Postoperative
photograph taken one year after subdermal treatment of
using the Smartlipo laser.
PATIENT HISTORY
A 52-year-old female sought treatment to reduce skin laxity and fat in her neck. Upon initial examination, she presented as a possible candidate for a neck lift. The patient indicated she was more comfortable with a less invasive procedure such as a Smartlipo MPX treatment. A complete pre-op blood count, chemistries, β-Hcg and coagulation studies were performed. The results of the blood count, chemistries, and coagulation testing were normal and the β-Hcg test was negative. The patient has a body mass index (BMI) of 30.8 kg/m². She was considered an ideal candidate for a Smartlipo MPX treatment.

SEDATIVE
Before treatment, the patient was given 20 mg of Valium and 10 mg of Percoset (with water) per oral.

PREPARATION AND MARKING
The submental area was divided into 5 x 5 cm sectors using a surgical marker. The treatment region included seven sectors in the neck and two sectors along the mandible. The total treatment area was 175 cm². Ten minutes after administration of the sedative, the patient was prepped with betadine, placed on the operating room table and draped in a sterile fashion.

ANESTHESIA
The procedure was performed under local anesthesia. The treatment area was pre-injected with 30 cc of 1% lidocaine with epinephrine using a 22 g spinal needle. The final stage of anesthesia was accomplished using an infusion cannula and 340 cc of tumescent solution. The tumescent solution contained 1 liter of lactated Ringer’s solution, 1% lidocaine and 1 cc of epinephrine 1:100,000, and 12 cc of 8.4% sodium bicarbonate.

SELECTION OF SMARTSENSE WITH THERMAGUIDE TEMPERATURE SETTINGS
SmartSense with ThermaGuide for Smartlipo MPX was utilized for this procedure. ThermaGuide is a smart, temperature-sensing 2.1 mm cannula that integrates with the SmartSense handpiece. SmartSense with ThermaGuide detects temperature directly where the laser energy is applied. The Smartlipo MPX workstation then detects ThermaGuide temperature readings and displays them on the screen. The application of Smartlipo MPX is automatically slowed and stopped when temperature readings are outside the target temperature zone. The temperature settings can be varied based on the technique and procedure using the Smartlipo MPX software. ThermaGuide was set to an initial warning temperature of 40°C, so the laser would stop when the tissue temperature reached 40°C and automatically begin again when tissue temperature fell below 40°C. ThermaGuide was also set with a high temperature limit of 45°C. At this temperature, laser treatment would be disrupted. These temperatures were selected based on scientific data and clinical experience with temperature rise when treating the submental area. Since epidermolysis occurs at 47°C (when measured at the skin surface), we chose to limit skin surface temperature to 40-42°C. The temperature may continue to rise after the laser has stopped delivering energy and additional clinical studies have shown there is a 2-3°C temperature differential between the subdermal and superficial temperature measurements in the neck area. This knowledge allowed us to optimize thermal heating while delivering a safe treatment when using ThermaGuide warnings of 40°C and 45°C.
SMARTLIPO MPX LASER PROTOCOL

A 600 µm Smartlipo MPX laser fiber was threaded through the ThermaGuide cannula and extended 2 mm beyond the tip of the cannula. The cannula was then inserted through a 2 mm incision created by a #11 blade. The Smartlipo MPX workstation was set to deliver a blend of 6 W, 1064 nm wavelength and 6 W, 1320 nm wavelength. The procedure was performed by applying laser energy and moving the cannula in a fanning motion through the treatment area. In the deeper fat layer, a total of 11,363 J was delivered until the clinical endpoint was achieved by the surgeon’s judgment of pliable tissue.

The treatment of superficial tissue was conducted by positioning the cannula subdermally. When applying laser energy, ThermaGuide™ enabled uniform treatment of the area while maintaining consistent temperature (refer to figure 1). The laser energy was delivered to the treatment area until the clinical endpoint was determined by using ThermaGuide. In addition skin surface temperature of approximately 40°C was verified and checked using a thermal camera.

Great care and diligence was used when working on the neck, since the skin of the neck tends to be thin. The energy used in the deep layer is often sufficient to heat the skin surface to about 40°C without having to apply additional energy in the superficial layer. In this case, only five of the seven sectors in the neck received both deep and superficial treatments. The sectors most lateral, those just at the angle of the mandible, carefully received just superficial laser treatment. A total 5,946 J was delivered superficially to the entire treatment area (five sectors in the neck and two sectors along the mandible).

ASPIRATION

After laser lipolysis, liposuction was performed using a 2.4 mm flat spatula cannula. A total of 110 cc was removed – 88 cc contained fat and the remaining volume was fluid. At the conclusion of the procedure, the incisions were closed with a single 6-0 Prolene™ suture and dressed with a Steri-Strip™.

POST-OP TREATMENT

The neck was prepped with Mastisol® and then strips of one-inch paper tape were placed horizontally across the entire anterior surface of the neck, beginning 3 cm above the supraclavicular notch up to the chin. This was done to encourage the adherence and eliminate dead space. A piece of Topifoam™ was cut to fit from ear to ear, along the new angle of the neck. A chin strap placed over the foam which was worn continuously for 72 hours, removed so the patient could shower, and then donned again for the balance the week. After one week, the tapes and sutures were removed and the patient was encouraged to wear the chin strap whenever possible for the following three weeks.

Minor swelling and bruising occurred over the clavicular region which resolved within the first three days. Pain was managed at home with either Percocet or Tylenol as needed. Antibiotics were given to the patient for one week post-operatively. The patient stated she was comfortable during the procedure and experienced only moderate pain the first day following the procedure, after which she felt fine. The patient returned to the office for one-week and one-month follow-up visits.

CONCLUSIONS

Smartlipo MPX laser-assisted lipolysis was an excellent choice for the elimination of unwanted fat and improvement of skin quality for this patient. The addition of the SmartSense with ThermaGuide intelligent delivery system also allowed for more precise and refined control of laser energy delivery while increasing patient safety. The patient was not interested in undergoing a more involved surgical procedure and stated she was happy with her results. At the age of 52, her skin responded well to the laser therapy. The Smartlipo MPX system worked by coagulating blood vessels and minimizing bruising. Use of the laser also easily disrupted the fat so a smaller cannula can be used (when compared to liposuction alone). The small-bore cannula was sufficient to remove the desired amount of fat to improve the patient’s neck contour. The smaller incisions also minimized trauma and potential scarring. All these factors resulted in a safer and improved outcome and overall greater patient satisfaction of the procedure.

Subdermal Tissue Temperature Using SmartSense with ThermaGuide

Figure 1

This figure depicts subdermal tissue temperature measurements over time using SmartSense with ThermaGuide. ThermaGuide was set to an initial warning temperature of 40°C. When tissue temperature exceeded 40°C, laser emission was automatically stopped as indicated by the grey bars. When the ThermaGuide cannula was moved to a different area where temperature was below 40°C, laser emission automatically resumed, ensuring a safer and more consistent outcome.
Patient Case Report

Laser-assisted Contouring of the Submental Area Using Smartlipo MPX™ and SmartSense™ with ThermaGuide™

Stephen Mulholland, MD
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PATIENT HISTORY
A 50-year-old female sought treatment for lipodistrophy of the submental area. Complete pre-op blood count, chemistries, β-Hcg and coagulation studies were performed. The results of the blood count, chemistries, and coagulation testing were normal and the β-Hcg test was negative. The patient has a body mass index (BMI) of 30.8 kg/m². Smartlipo MPX treatment was recommended to treat the lipodistrophy and elastosis.

SEDATIVE
Before treatment, the patient was given 20 mg of valium and 10 mg of Percocet with water.

PREPARATION AND MARKING
The submental area was divided into four zones using a surgical marker: two 5 × 5 cm and two 10 × 5 cm sectors (see Figure 1). The total treatment area was 150 cm². The patient was prepped with betadine and draped in a sterile fashion.

ANESTHESIA
The procedure was performed under local anesthesia. Anesthesia was accomplished using an infusion cannula and 300cc of tumescent solution. The tumescent solution contained 1 liter of lactated Ringer’s solution, 1% lidocaine and 1 cc of epinephrine 1:100,000, and 12 cc of 8.4% sodium bicarbonate.

SELECTION OF SMARTSENSE WITH THERMAGUIDE TEMPERATURE SETTINGS
SmartSense with ThermaGuide for Smartlipo MPX was utilized for this procedure. ThermaGuide employs a thermal-sensing cannula (2.1 mm) that measures the subdermal temperature and provides this information to the Smartlipo MPX workstation.

Temperature settings were predetermined to provide a temperature threshold.

In this case, the initial temperature threshold was set at 40ºC, so that the laser would briefly stop delivery of thermal energy when the tissue temperature reached 40º C. ThermaGuide was also set with a high temperature limit of 45ºC; at this temperature, laser treatment would be disrupted.

Since epidermolysis occurs at 47ºC when measured at the skin surface, we chose to limit skin surface temperature to 40ºC. Temperature may continue to rise after the laser has stopped firing and additional clinical studies have shown there is a 2-3ºC temperature differential between the subdermal and superficial temperature measurements in the neck.

SMARTLIGO MPX LASER PROTOCOL
A 600 µm Smartlipo MPX laser fiber was threaded through the ThermaGuide cannula and extended 2 mm beyond the tip of the cannula. The Smartlipo MPX workstation was set to blend 1 of 6 W, 1064 nm wavelength and 6 W, 1320 nm wavelength. The procedure was performed by moving the cannula in a fanning motion through the treatment area while delivering the laser energy.

Figure 1: Four sectors of treatment areas.
The treatment of superficial tissue was conducted by positioning the cannula subdermally. ThermaGuide enabled uniform treatment of the area while maintaining consistent temperature (refer to Figure 2). The laser energy was delivered to the treatment area until the clinical endpoint was determined, using ThermaGuide at a temperature limit of 40 °C. Also, the endpoint was determined when the epidermal temperature measured approximately 40°C by a handheld noncontact digital thermometer.

**SECTOR 1**
Sector 1 was comprised of the left lateral side of the face, the mandibular border, and the submental area approximately 10 × 5 cm. Prior to the delivery of energy, the subdermal ThermaGuide™ temperature measured 29° C while the epidermal temperature measured 31°C. At 1,765 J, the internal subdermal temperature began to register at 40°C and the external epidermal temperature reached 36°C. The energy delivery was intermittent from this point forward.

At 2,019 J, both the epidermal and subdermal temperatures registered 40°C. The temperature did not exceed the predetermined threshold of 40°C and provided a gradual, safe window of energy delivery.

**SECTOR 2**
Sector 2 was comprised of the left medial section of the submental area and represented a 5 × 5 cm area. Prior to the delivery of energy, the external epidermal temperature measured 29°C with the external thermometer and the subdermal ThermaGuide temperature measured 31°C. At 465 Joules, the internal temperature began to register at 40°C and the external temperature reached 34°C. The energy delivery was intermittent from this point forward. At 819 J, the epidermal temperature registered 40°C and subdermal temperatures registered 39°C.

**SECTOR 3**
Sector 3 was comprised of the right lateral side of the face, the mandibular border, and the submental area and comprised a 10 × 5 cm area. Starting subdermal temperature was 33°C. At 2,144 J, both the epidermal and subdermal temperatures registered 40°C.

**SECTOR 4**
Sector 4 was comprised of the posterior medial section of the submental area and represented a 5 x 5 cm area. Prior to the delivery of energy, the subdermal ThermaGuide temperature measured 35°C and the external epidermal temperature measured 34°C with a handheld thermometer. These initial increased temperature measurements reflect the diffusion of thermal energy from the previously treated areas. At 240 J, the subdermal temperature began to register at 40°C and the epidermal temperature reached 37°C. The energy delivery was intermittent from this point forward. At 432 J, both the epidermal and subdermal temperatures registered 40°C (see figure 2).

**SUMMARY**
A total of 3,414 J was delivered to the four areas of the submental region. A consistent and safe subdermal and epidermal temperature of 40°C was achieved throughout the treatment area. Laser energy was delivered for 16 minutes total.

**CONCLUSIONS**
Smartlipo MPX with ThermaGuide was used in conjunction with a surface monitoring device to provide a safe delivery of thermal energy—based on a predetermined temperature setting recommended from clinical studies. The delivery of this energy was targeted and controlled within the superficial layer, providing an appropriate margin of safety.

![Subdermal Tissue Temperature Using SmartSense™ with ThermaGuide](image)

Figure 2.
This figure depicts actual subdermal tissue temperature measurements for sector 4 using SmartSense with ThermaGuide. ThermaGuide was set to an initial warning temperature of 40°C. When tissue temperature exceeded 40°C, laser emission was automatically stopped as indicated by the grey bars. When the ThermaGuide cannula was moved to a different area where temperature was below 40°C, laser emission automatically resumed, ensuring a safe and consistent outcome.
PATIENT HISTORY
The patient was a 56-year-old male complaining of skin laxity of the lower face and neck. He was of normal weight, and medical screening consultation revealed no significant medical history. For optimal results, a rhytidectomy surgery was recommended. However, the patient was interested in a less invasive option that would yield similar tightening results to the lower face and neck areas. The SmartLook with UltraMini Neck Lift procedure was suggested as an alternative option.

SMARTLOOK WITH ULTRA MINI NECK LIFT
The SmartLook, also known as LaserFacialSculpting, with UltraMini Neck Lift, is a combination procedure that has become a popular alternative to invasive neck and face lifts. More frequently, patients are looking for cosmetic and medical procedures that are less invasive and allow for a quicker, less traumatic treatment and recovery. The SmartLook with Ultra Mini Neck Lift procedure is a minimally invasive neck lift that utilizes Smartlipo MPX to separate the skin and tighten through tissue coagulation and allow for sutures to be applied to the neck muscles for the lift component.

ANESTHESIA & SETTING
The procedure was performed under local anesthesia supplemented by mild intravenous sedation (midazolam/fentanyl) in a state-licensed, nationally accredited, ambulatory surgical center. A total of 250cc tumescent solution (modified Klein’s solution) was administered to the treatment area.

TECHNIQUE
After anesthesia and sedation were given, the neck area was divided and treated in a series of 5.5 cm² by 5.5 cm² sections (twelve total) for the entire midline and lateral sides of the neck. The procedure was performed through small “access incisions” of about 1 to 1.5 cm created in the submental crease and adjacent to the lobules.

The Smartlipo MPX laser was set to Blend 3, 9W for the procedure. Approximately 7,000 to 10,000 J/cm² were delivered by a 600 µm fiber to each treatment section. Subdermal temperatures were preset with the ThermaGuide™ thermal sensing cannula to 45°-50° C and external skin temperatures were measured with a handheld thermometer and maintained at 40°-42° C.

After utilizing the laser to undermine the lower facial and neck skin, aspiration of 30cc to 50cc of fat and fluid was completed. The neck lift consisted of placing a Quill™ SRS 3-0 Polydioxanone (PDO) monofilament synthetic absorbable suture through the head of the platysma muscle, extending to the contralateral mastoid periosteum, where a small incision was made to retrieve and anchor the suture. This “hammock” technique, which was then repeated on the contralateral side, provides additional refinement to the neck contour improvement than can be achieved with lipolysis alone. The Quill SRS suture requires no knots and locks into tissue, providing good definition of the mandibular border.

Skin closure was completed with absorbable sutures and a light compressive dressing was applied for the first 24 to 48 hours. The dressing was replaced with an elastic facial wrap used at bedtime and during the day as tolerated for an additional thirty days.
POSTOPERATIVE CARE
Patient was evaluated at 24- and 48-hours postoperative. There was minimal swelling or bruising. Improvements were immediately apparent in the 48-hour and one-week postoperative photos. The patient was satisfied with the improvements in the appearance at that time. Additional refinement and tightening is expected for up to six months.

CONCLUSION
The benefits of using the Smartlipo MPX laser in addition to the neck lift incision surgery were three-fold:

1. The hemostasis resulting from the laser energy enabled better visualization though the small incisions during the procedure;
2. Skin separation from the deep neck musculature in the appropriate plane was simplified during the procedure; and
3. The laser provided tissue tightening that was cosmetically significant after the procedure.

With minimal access incision surgery alone, it would be difficult to achieve the tissue separation (skin and muscle) with the same degree of hemostasis as achieved with the addition of the Smartlipo MPX laser. The laser provides a pre-treatment of the surgical site and helps develop the ideal plane for neck lift surgery. The SmartLook with UltraMini Neck Lift procedure allows surgery to be performed through small incisions with minimal bleeding while increasing tissue tightening and enhancing skin lifting.

The patient observed greater improvement both immediately and long-term with the combined SmartLook with UltraMini Lift procedure than with liposculpture alone. Improvements include:

- A significant neck lift as a result of the anchored position to the mastoid periosteum; and
- Contour improvements achieved by lipolysis, liposculpture, and tissue tightening.

Together the improvements result in an excellent cosmetic outcome.
References


9. Collawn SS “Skin Tightening with Fractional Lasers, Radiofrequency and Smartlipo” Annals of Plastic Surgery Volume 64 Number 5 May 2010

10. Cynosure Clinical Finding “Tissue Treated with Continuous Wave Laser Results in More Bleeding when Compared to Tissue Treated with Smartlipo MPX” P/N: 921-0117-000 October 2008


44. Leibaschoff G et al. “A double-blind, prospective, clinical, surgical, histopathological and ultrasound study comparing the effectiveness and safety of liposuction performed using laserlipolysis (Smartlipo) and Internal Ultrasound (Vaser) method, and assessing the evolution in patients”


Appendix A: Peer Reviewed Articles Summary

Laser Physics


**Objective:** The authors present the concept of selective damage to tissue through pulsed radiation and a simple scheme for confining thermally mediated radiation to chosen tissue targets.

**Conclusion:** The feasibility of vascular, cellular and ultrastructurally specific selective photothermolysis is apparent. Cell specific selective photothermolysis affects large cell numbers without widespread tissue damage.


**Objective:** Determine if infrared vibrational bands could be used for selective photothermolysis of lipid rich tissues such as fat and sebaceous glands.

**Conclusions:** Selective photothermal targeting of fatty tissues is feasible using infrared lipid absorption bands. Photothermal excitation of fat was twice that of the dermis, at lipid absorption bands (1210 and 1720nm) when laser energy was applied through the skin. The absorption spectra of human fat extract and water are depicted.
Appendix B: Peer Reviewed Articles Summary

Histological Studies


Objective: Histologic analyses of the effects of the laser on human fat tissue.
Study Population: Freshly excised human skin and subcutaneous fat were irradiated with the pulsed 1064 Nd:YAG laser (Smartlipo, DEKA, Italy).
Conclusion: Greater destruction of human adipocytes than in the control. Degenerated cell membrane, vaporization, liquefaction, carbonization and heat-coagulated collagen fibers were observed.


Objective: The first study to demonstrate the histological and photonic relationship of energy absorption and lipolysis using a pulsed Nd:YAG laser.
Study Population: In plastic surgery operations, tissues were taken from three subjects as excised excess parts of skin flaps containing sufficient subcutaneous fat.
Conclusion: Findings of tissue evaporation, destruction, heat coagulation and rupture of cell membrane were more frequently seen in irradiated specimens than in controls in scanning electron microscopy. The affected area in the high-power irradiated groups was significantly larger than that of low-powered specimens.


Objective: A comparative histologic evaluation of laser lipolysis with the pulsed 1064 nm Nd:YAG laser versus a continuous 980 nm diode laser.
Study Population: Biopsy specimens.
Conclusion: Histologic findings suggest several positive benefits of the pulsed laser, including skin retraction and a reduction in intraoperative bleeding. The interaction of the laser with the tissue is similar at CW 980 nm and pulsed 1064 nm with the same energy settings.


Objective: To compare the histologic effects on ex vivo human fatty tissue using three separate wavelengths of laser light (1064, 1320 and 2100 nm) at three predetermined energy levels.
Study Population: Nine samples of freshly harvested abdominal subcutaneous tissues were studied in a blinded fashion.
Conclusion: Light microscopy after irradiation showed thermal damage in the subcutaneous tissue that preferentially affected the fibrous septae with some fat cell damage. The diameter of thermal damage around the fiber ranged from 1 to 4-5 mm depending on the laser wavelength and average power of the settings. No clear fat liquefaction was seen histologically in the ex vivo samples but was seen with the 1320 nm Nd:YAG irradiation of the in vivo lipoma tissue.

Objective: To compare the histologic and morphometric effects of laser-assisted lipolysis with those of the traditional method.

Study Population: Performance of procedure on patient’s right flank in two different areas. Comparison material was obtained from traditional lipoplasty performed on the left flank of the same patient.

Conclusion: The histopathological examination of adipose tissue after laser lipolysis showed cell swelling and less bleeding as compared with the traditional method. The morphometric analysis showed that the mean diameter of the major adipocyte was 95.69 μm with laser lipolysis using 1,000 J (∈), 82.63 μm using 3,000 J (∈) and 84.54 μm with the traditional method.


Objective: Determine the effects of the 1064nm and 1320nm Nd:YAG lipolysis on fresh ex vivo human abdominal fat pads. The wavelengths were assessed at variable fluences and the extent of dermal and epidermal coagulation following subcutaneous laser lipolysis was analyzed by histological tissue analysis.

Study population: 13 Abdominoplasty specimens - 2.5x2.5cm study segments

Conclusion: Histological analysis demonstrated a wavelength dependant differential dermal response. Increasing fluence lead to progressively more dermal coagulation with epidermal thermal injury. The 1320nm Nd:YAG lead to more extensive collagen coagulation when compared to the 1064nm Nd:YAG. It was determined that 27 to 89J per cm³ is an ideal optical energy density for dermal focal coagulation using 1064 nm Nd:YAG. An ideal optical energy density of 27 J per cm³ using 1320 nm was observed.

**Objective:** To present experience using Nd:YAG laser to treat lipodystrophies.

**Study Population:** 1,734 surgical procedures performed in three centers for cosmetic surgery. Of the total, 82% (1,421 patients) were women and 18% (312) men. Ages ranged between 25-78 years.

**Conclusion:** Although observations are preliminary and more studies and follow-up are needed, laser lipolysis with a 1064 nm Nd:YAG laser, using tumescent infiltration technique with peristaltic infusion pump, proved to be a method with low malacic loss, a low rate of ecchymosis and little discomfort in the postoperative period.


**Objective:** To describe the experience with neck and jowl using Nd:YAG laser-assisted liposuction.

**Study Population:** 82 subjects over a 5-year period. Histology was performed on fatty tissue samples.

**Conclusion:** The Nd:YAG laser is a useful tool for the treatment of local lipodystrophy. The laser proved to be effective for cellular lysis and collagen neoformation.


**Objective:** A review article to explore laser-assisted lipolysis in men.

**Conclusion:** Liposuction in men is commonly applied to areas that may also be quite fibrous, such as the breasts, abdomen, and hip rolls. The use of conventional liposuction can often be traumatic in these fibrous areas. SmartLipo could be considered as an alternative as it can be less traumatic and lessen the recovery time.


**Objective:** To determine the safety and efficacy of 1064 nm Nd:YAG laser with a 300 µm fiber for the reduction of small unwanted fat areas.

**Study Population:** 30 patients with focal areas of fat less than 100 cm³.

**Conclusion:** Of 29 patients completing the trial, 37% reported an improvement at the 3-month follow-up visit. The most common side effects were mild bruising and swelling, which resolved within 2 weeks. The investigators conclude that laser lipolysis appears to be a very promising procedure that delivers good, reproducible results safely and effectively. The advantages include excellent patient tolerance, quick recovery time, as well as the benefit of dermal tightening.


**Objective:** A prospective, randomized analysis of clinical experience with the use of Nd:YAG low-level laser-assisted lipoplasty.

**Study Population:** 25 patients underwent laser-assisted lipoplasty and suction-assisted lipoplasty on one side compared with suction-assisted lipoplasty on the other. Comparisons were made preoperatively and postoperatively with photographs at days 3-5, at days 12-15 and at months 6-11.

**Conclusion:** No complications were observed. Less pain, lower lipocrits, higher triglycerides and DNA cellular membrane traces were detected in the laser-assisted lipoplasty sides. All other considerations showed no differences with either technique in the three periods of follow-up. Cytologic studies showed more damage of the adipocytes in the laser-assisted lipoplasty sides.

Objective: This FDA approved study of laser assisted liposuction was conducted to determine safety of the procedure when using an Nd:YAG laser.

Patient Population: 51 patients over 5 plastic surgery centers.

Conclusion: All patients were able to return to work after six days and resume light exercise after seven days. The drop in hemoglobin was modest after surgery. Contralateral studies showed a benefit for the laser side at both one and eight weeks for ecchymosis, pain, discomfort and edema.


Objective: Presentation of a new innovative technique using a 1064nm Nd:YAG laser in conjunction with liposuction. The objective of the new device is to achieve lipolysis and to affect collagenous tissue inducing it’s retraction and subsequently skin shrinkage.

Study Population: 245 patients, 6 men and 239 women, average age 35, with a range of 17-55.

Conclusion: Laser lipolysis was demonstrated to be less traumatic than conventional liposuction methods. Pathology studies demonstrate the reduction in bleeding resulting from coagulation of small blood vessels. Histology also demonstrates the laser’s thermal effect liberates the retracted skin and remodels the collagenous tissue, with clinically evident skin retraction. The tissue interaction produced less swelling and good contour. Thermal complications were not experienced.


Objective: This study systemically evaluates tissue heating for superficial and deep laser lipolysis, using 3 approaches and correlates temperature rise with histology changes in order to define appropriate system parameters. Histology was correlated to tissue temperature to determine appropriate temperature limits.

Study population: 66 abdominoplasty specimens from 2 patients

Conclusions: Results of the study provide guidance of tissue temperatures and treatment doses likely to provide safe alteration of tissue collagen for lipolysis and tissue tightening. It also provides guidance to avoid excessive heating of surface and deep tissue structures. As a guideline for clinical laser-assisted lipolysis, surface temperature should be at or slightly below 42°C. Deep tissue heating is recommended at 67-133 J/cm² or 1675-3325 J in a 5-cm sector.


Objective: This comprehensive article provides an overview of techniques, history, science, indications and results of laser-assisted lipolysis.

Conclusion: By reducing blood loss, minimizing aesthetic and anesthetic side effects and complications and by promoting improvements in tissue contraction and redraping following surgery, laser assisted liposuction has proven itself to be a safe, effective and useful procedure for the surgeon performing body contouring procedures.


Objective: To determine the number of adverse events associated with Laser Assisted Lipolysis (LAL) and the frequency with which secondary procedures had to be performed post the primary procedure to correct defects.

Study population: 537 patients

Conclusions: LAL is a safe and effective technology for treating localized areas of adiposity. There were five minor complications, yielding a complication rate of 0.93%. All complications were successfully treated and were resolved without further issue. No systemic complications occurred. Touch-up were required 19 times of the total, a rate of 3.5% compared to a 12% rate for more conventional methods of liposuction.

Objective: This comprehensive paper summarizes the latest techniques and treatments available for the aging neck.

Conclusion: The authors have found that the use of Laser Assisted Lipolysis (LAL) alone has led to high levels of patient satisfaction regarding fat volume and skin tone and skin redraping. Recent evaluation of our results demonstrated that high levels of satisfaction with the procedure in the neck encouraged patients to have LAL on other areas of the body.

Collawn SS “Skin Tightening with Fractional Lasers, Radiofrequency and Smartlipo” Annals of Plastic Surgery Volume 64 Number 5 May 2010

Objective: The objective of this study was to determine the best methods for smoothing, firming and tightening of the neck either singularly or in combination with various procedures.

Study Population: From September 10, 2007 until October 6, 2008, 255 patients were treated.

Conclusion: Tissue tightening occurs with the use of fractional lasers, radiofrequency, and Smartlipo. Fractional lasers and monopolar radiofrequency result in tightening and decreased rhytides, particularly when the devices are used in combination. Smartlipo MPX results in tissue tightening with a decrease in rhytides either solo or in combination with the above procedures. Heat generated by the laser results in coagulation changes in the underlying subcutaneous tissue and dermis and these heat induced alterations promote tissue tightening which is immediate and improves over time. The best results have been with the combination of Smartlipo MPX and Smartskin microablative CO₂.


Objective: The goal of this study was to gather and analyze data on the effects of dual wavelength (1064nm/1320nm Nd:YAG) subdermal laser lipolysis on skin shrinkage (reduction of area and tissue tightening (elasticity) and to determine an objective and quantifiable method for documenting these changes in the skin.

Study Population: 20 skin sectors evaluated from 5 patients

Conclusion: At three months post-operatively, the average skin elasticity index was increased by 26%, the average reduction in skin area was 17%. Both results were significantly higher at three months post-op than at baseline readings. These findings represent the first documented evidence of positive skin changes resulting from the addition of laser treatments to liposuction procedures.

DiBernardo BE, “Randomized, Blinded Split Abdomen Study Evaluating Skin Shrinkage and Skin Tightening in Laser-Assisted Liposuction Versus Liposuction Control” Aesthetic Surgery Journal October 2010; 30(4) 593–602

Objective: The aim of this study was to obtain quantitative, objective data for comparing tissue shrinkage and tissue tightening achieved by laser-assisted lipolysis with liposuction compared to liposuction alone. On the abdominal skin of each patient, the corners of four regions (approximately 5 × 5 cm each) were tattooed and randomly assigned to treatment with laser-assisted lipolysis plus liposuction or with liposuction alone. The Smartlipo MPX laser system was used. Skin shrinkage was quantified by calculating the changes in surface area of the regions. Tissue tightening was quantified by changes in the skin stiffness index measured in the treated regions.

Study Population: 40 skin sectors evaluated from 10 female subjects
**Conclusions:** Three months after treatment, mean skin-tightening improvements were 62% for the laser side and 5% for the suction side. The mean of the individual skin shrinkage improvement ratios showed 54% greater shrinkage than liposuction alone at three months. Laser-assisted lipolysis followed by liposuction has a statistically significant effect on skin shrinkage and tightening of the skin in the abdominal area when compared to liposuction alone.


**Objective:** The purpose of this study was three-fold: 1) Evaluate the safety and efficacy of a sequentially firing 1064nm/1320nm Nd:YAG laser with accelerometer for laser assisted lipolysis, 2) Evaluate tissue tightening effects through photo documentation and skin measurements 3) Asses new collagen formation through histology and scanning electron micrograph (SEM) images.

**Study Population:** 20 subjects with unwanted adiposities and skin laxity

**Conclusions:** Results showed reduction in localized adiposities with no adverse events from this device. Tattoo marking on some patients demonstrated an 18% improvement in skin area shrinkage when compared to baseline. Histology, SEM images demonstrated an increase in collagen formation post procedure when compared to baseline images.


**Objective:** The safety and efficacy of a 1064-nm Nd:YAG laser utilizing a 300-μm optical fiber and a 1-mm diameter micro-cannula were evaluated as a treatment for reduction in the appearance or elimination of unwanted fat in the lower back/flanks. In addition, the use of the laser for tissue tightening and collagen regeneration in the area of lipolysis was assessed through biopsies. Laser lipolysis procedures with subsequent aspiration were performed bilaterally on the flanks of 10 subjects.

**Study Population:** Ten subjects with unwanted flaccidity and fat deposits in the oblique region of the torso were enrolled in the study

**Conclusions:** At 1-week post-treatment, 80% of the subjects demonstrated reduction in laxity. Similarly, 100% of patients showed visible skin improvement at 1 month, with 70% recording a score of 2 (good improvement). Three month evaluations yielded one patient (10%) with a score of 3 (excellent improvement) and seven patients (70%) with a score of 2. Histology reports confirmed the visual clinical outcomes, describing thicker collagen bundles at 6 months, as well as coagulation of blood vessels and adipocytes. Side effects were mild and transient in nature, and the majority of discomfort, redness, bruising, swelling, and tingling experienced was resolved within 1 week post-procedure. The treatment was well tolerated and efficacious, with 90% of patients rating their results as good or excellent and 100% of patients reporting that they would recommend the procedure.


**Objective:** The purpose of this study was to evaluate tissue tightening using Vectra 3D analysis of patients treated with an 1064nm/1320nm Nd:YAG laser for laser assisted lipolysis. Objective measurements were correlated to histologic findings during treatment. Temperature was monitored on the skin surface as well as subermally to track and determine proper endpoints.

**Study Population:** Six 4x10cm rectangles treated on 3 different patients

**Conclusions:** This study reports the effects of temperature on tissue tightening as determined by Vectra 3D imaging analysis correlated with histological changes of collagen denaturization in the reticular dermis. Control sites with tumescence alone or cannulation alone resulted in minimal tissue tightening since thermal injury and/or volume loss did not occur. Areas treated with the laser show higher levels of tissue tightening and area shrinkage improvement.

Objective: Several laser lipolysis systems were evaluated 1064nm at 10W, 1320nm at 10W and Smartlipo MPX 1064nm/1320nm at 20W and 16.5W. Temperature was monitored using an external thermal camera system.

Study Population: 38 female patients

Conclusions: The Smartlipo multiplex 1064nm/1320nm laser system showed improvement in skin laxity that seemed to exceed the 10W individual wavelength systems. On the basis of the chromophores for 1064nm and 1320nm, the sequential firing of these 2 wavelengths targets both blood and water to deliver optimal results. It was determined that generating enough energy to reach an endpoint of 40°C on the skin surface was important for efficacy.
Appendix D: Peer Reviewed Articles Summary

Studies Regarding Research Advancements


Objective: To evaluate the Nd:YAG laser as a safe and effective option for the treatment of axillary hyperhidrosis.
Study Population: 17 patients (15 women and 2 men)
Conclusion: The treatment of axillary hyperhidrosis using the 1064 nm Nd:YAG laser has the advantage of a minor invasive procedure without leaving large scars and causing temporary impairment. The laser proved to be effective and safe. Results were reported to be good or excellent by 88% of patients. Patient were asymptomatic between 12 to 43 months at the time of the study.


Objective: The authors sought to show whether or not the application of an Nd:YAG laser combined with autologous fat transplantation is a safe and effective treatment for cellulite.
Study Population: 52 female patients with grade III to IV cellulite
Conclusion: Treatment of severe cases of cellulite were proven to be safe and effective and represents a new treatment for cellulite disorder. Results demonstrated mild or temporary adverse events and a post-operative period that was well tolerated. Results were rated as either good or excellent 84.6% of patients.


Objective: To evaluate the efficacy of subcutaneous intralesionl application of a pulsed Nd:YAG 1064nm laser as an option for the treatment of lipomas
Study Population: From January 2001 to November 2007, 20 patients (11 women and nine men) with lipomas were treated.
Conclusions: Subdermal lipoma treatment using a 1064-nm Nd:YAG laser resulted in complete or almost complete removal of the tumor in 100% of patients. Four partial relapses were observed that were treated successfully by the same procedure. Adverse effects were mild and temporary. The combination of a 1064-nm Nd:YAG laser and removal of the cell debris by a suction cannula presented an effective therapeutic option for patients with lipoma. This treatment approach was a minor invasive procedure which does not result in large scars.


Objective: Lipomas which occur in 1% of the population can be cosmetically unacceptable for many patients. Excision of these benign tumours may leave unacceptable scarring, this case report describes a new method for treating lipomas using a laser lipolysis device followed by digital extraction using a 1.5mm opening to reduce scarring.
Study Population: A 39 year old male subject with multiple lipomas present on his arms and trunk area.
Conclusions: Pre-treating lipomas with laser lipolysis before extraction minimizes complications such as post-operative scarring, hematoma formation and dimpling from liposuction alone. Mild echymosis was present post procedure. The addition of the Nd:YAG laser in multiplex mode helps with bruising due to the coagulation effects of the laser.
Laser lipolysis redefined
Only Smartlipo TriPlex now offers three wavelengths including 1440 nm for faster fatty disruption. It’s laser lipolysis redefined — only from Cynosure. Why settle for anything less?