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ORIGINAL ARTICLE

## Laser-assisted lipolysis: A report on complications

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### Abstract

**Background:** As reported elsewhere, there are several drawbacks associated with traditional liposuction: increased blood loss, ecchymoses, long recovery times with increased postoperative discomfort, and skin laxity. Laser-assisted lipolysis (LAL) is an emerging technology, but the level of safety associated with this device has not been reported. In October 2006, a 1064-nm Nd:YAG laser was approved by the United States Food and Drug Administration for the surgical incision, excision, vaporization, ablation, and coagulation of all soft tissues and has been used for LAL as well as improvement of areas of flaccidity. The objective of this new device is to melt fat while also reducing the blood loss, ecchymoses, long recovery times and skin laxity. It achieves these improvements by destruction of adipocytes, coagulating small blood vessels and collagen, the end result being reduced adiposity, skin retraction and decreased flaccidity. **Objective:** To determine the number of adverse events associated with LAL and the frequency with which secondary procedures had to be performed after the primary one to correct defects (touch-up rate). **Methods:** A total of 537 consecutive LAL cases were performed with tumescent anesthesia between January 2006 and November 2007 at one center. These 537 cases were reviewed retrospectively to determine the number of adverse events associated with the LAL procedure and the number of touch-up procedures performed. **Results:** No systemic complications were identified and only five local complications were found. These complications included one local infection and four skin burns. This represents a complication rate of 0.93%. Nineteen touch-up procedures were necessary: a rate of 3.5%. **Conclusion:** Laser-assisted lipolysis (LAL) is a safe adjunct to traditional tumescent liposuction which assists in melting fat and tightening the skin. LAL may serve as a useful tool for the surgeon performing liposuction.

**Key words:** Laser-assisted lipolysis, liposuction, 1064 Nd:YAG, skin tightening, Smartlipo

### Introduction

Liposuction is the most common cosmetic surgical procedure performed in North America, with over 400 000 operations performed in 2006 (1). When traditional liposuction is performed under general anesthesia, major systemic complications have been reported, including death. This has generated significant concern in the medical and lay community about the safety of this popular procedure. Liposuction, when performed under local tumescent anesthesia, has been associated with few systemic side effects and no deaths. Laser-assisted lipolysis (LAL) is an emerging minimally invasive technology whereby a laser fiber is inserted under the skin to melt fat and has been reported to tighten skin as well.

Since January 2006, this center has performed over 500 LAL cases with a pulsed Nd:YAG 1064-nm laser system (Smartlipo; manufactured by Deka,

distributed by Cynosure, Westford, MA, USA) The purpose of this study was to determine whether LAL is associated with an increase in the rate of adverse events as well as necessary touch-up procedures.

### Methods

In this study, 537 consecutive LAL cases performed with tumescent local anesthesia between January 2006 and November 2007 by a dermasurgeon and a plastic surgeon were analyzed retrospectively using chart review. A total of 466 female and 71 male patients comprised the study group. The age ranged from 17 to 77 years. Charts were reviewed for complications associated with tumescent local anesthesia that had been previously reported in the literature and were divided into local and systemic complications.

Local complications that were reviewed included skin or subcutaneous infection, permanent skin irregularity (dimpling, retraction), seroma, allergic contact dermatitis to tape, skin ulceration or necrosis, permanent sensory nerve damage, unacceptable scars, and persistent postoperative edema.

The systemic complications that were reviewed included allergic reaction to oral or intramuscular medication, fevers, systemic infection, arrhythmias, anemia, fluid or blood loss requiring a transfusion, pulmonary emboli, fat emboli, shock, bowel or thoracic perforation, seizures, thrombophlebitis and death.

Preoperatively, patients received intramuscular meperidine, hydroxyzine and midazolam as well as oral clonidine. These are administered to enhance patient comfort. All cases were performed using the tumescent technique. The tumescent anesthesia consisted of 1 l of normal saline, 1 ml of 1:1000 epinephrine, 50–75 cc of 1% lidocaine and 12.5 cc of 8.4% sodium bicarbonate. In no cases did the amount of tumescent anesthesia administered exceed 55 mg/kg.

The laser used was a pulsed 1064-nm Nd:YAG system with a pulse width of 150 ms and a repetition rate of 40 Hz. The power output ranged from 6 W to 10 W. The laser was directed subcutaneously in a criss-cross pattern until the endpoint of subcutaneous tissue softening and reduction by palpation was reached. The laser treatment was followed by suction aspiration to remove liquefied adipose tissue.

## Results

A total of 537 patients underwent LAL. There were five complications including one skin infection and four skin burns, yielding a complication rate of 0.93%. All of the burns were successfully treated with topical emollients or antibacterial ointments and the infection resolved without sequela. No systemic complications occurred. Touch-ups were required 19 times out of the total 537 patients: a rate of 3.5%.

## Discussion

In 1994, Apfelberg et al. conducted the first multicenter trial studying laser-assisted lipolysis (LAL). A 40 W Nd:YAG laser with a 0.2 s pulse duration and 600  $\mu\text{m}$  fiber was placed in a 4- or 6-mm cannula requiring cold saline cooling. The encased laser fiber was not in direct contact with the fatty tissue. The study suggested a trend toward decreased ecchymoses, pain and edema, and less strain for the physician (2). In 2002, Badin et al. investigated histological features after thermal damage using a different 1064-nm YAG laser (SmartLipo; Cynosure). The laser disrupted adipocyte membranes, coagulated blood vessels and

reorganized new collagen, and was felt to have benefits in areas of increased skin flaccidity (3). A subsequent study by Goldman using the same laser documented less blood loss and ecchymoses, improved patient comfort postoperatively, and better efficacy for reducing fat in more dense areas such as gynecomastia (4).

Ichikawa et al. evaluated freshly excised human skin and subcutaneous fat then irradiated the tissue with this same pulsed Nd:YAG laser. The changes included 300- $\mu\text{m}$  tunnels that corresponded to the laser fiber diameter, disintegrated cell membranes, small vessel coagulation and dispersed lipids (5). Scanning electron microscopy after irradiation showed greater destruction of the adipocytes than in the control group. Degenerated cell membrane, vaporization, liquefaction, carbonization, and heat-coagulated collagen fibers were observed (6). The study concluded that LAL appeared to be histologically effective for the destruction of human fat tissue.

Finally, a 2006 study by Kim and Geronemus, used magnetic resonance imaging (MRI) to evaluate the volume of fat reduction after laser lipolysis (8). In addition to the 17% fat volume reduction documented by MRI, patients noted a 37% improvement in only 3 months, quick recovery times and good skin retraction.

LAL is an exciting new technology for liposculpture. This device has been used specifically to: (1) liquefy adipose tissue; (2) sculpt and shape localized areas of adiposity such as the submental area, upper arms, abdomen, inner thighs, outer thighs, knees and ankles; and (3) tighten the skin, particularly in areas in which removal of adipose tissue may leave flaccid skin.

The safety concerns that physicians must anticipate when employing new lasers include burns, purpura, scarring, retinal and corneal damage, hyper- and hypopigmentation, necrosis, and nerve damage. When performing liposuction, risks are categorized as local or systemic. Local risk factors associated with liposuction (tumescent or liposuction under general anesthesia) are skin or subcutaneous infection, permanent skin irregularity (dimpling, retraction) seroma, allergic contact dermatitis to tape, skin ulceration or necrosis, permanent sensory nerve damage, unacceptable scars, and persistent postoperative edema. The systemic complications include allergic reaction to oral or intramuscular medication, fevers, systemic infection, arrhythmias, anemia, fluid or blood loss requiring a transfusion, pulmonary emboli, fat emboli, shock, bowel or thoracic perforation, seizures, thrombophlebitis and death. When combining lasers with liposuction, the list of potential complications does indeed grow.

While the list of potential complications may be long, in our experience of over 500 cases the actual complications have been rare. One patient developed

a localized infection successfully treated with oral antibiotics and four patients developed skin burns. The burns were treated with topical antibacterial ointments. The burns likely occurred secondary to a rapid accumulation of thermal energy localized to one area. One way to prevent burns is to keep the cannula moving and avoid keeping the laser in one location for too long. Another way to potentially prevent inadvertent burns is to monitor the skin with a thermal scanning device that measures cutaneous temperature carefully.

An additional safety concern is the theoretical possibility of nerve damage. In the 537 cases performed at our center, there were no cases of persistent neuropathy, paresthesias or numbness. Earlier studies by Goldman et al. demonstrated histologically intact nerve fibers with surrounding disintegrated adipose tissue, suggesting a selective thermolytic effect (7). Another issue of concern is the possibility of increased serum lipids as a result of lipolyzed adipose tissue. Earlier studies by Goldman and colleagues found no significant change in triglycerides and lipid profiles among patients treated with LAL at 1 day, 1 week and 1 month post-procedure.

In our experience, LAL is a safe and effective technology for treating localized areas of adiposity. It has also led to fewer touch-up procedures compared with traditional liposuction. In over 500 cases utilizing LAL and the tumescent technique, 19 touch-up procedures were necessary. These 19 patients comprise only 3.5% of the total liposuction cases completed at our center. In contrast, Lawrence and Butterwick studied the number of touch-up

procedures at a large liposuction practice and found that over 12% of 954 liposuction cases required a touch up (8). The lower touch-up rate associated with LAL suggests enhanced uniform removal of adipose tissue, thereby contributing to improved physician control and precision of body contouring.

**Declaration of interest:** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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