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Progress Report on Multicenter Study of Laser-Assisted Liposuction

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Abstract. Fifty-one patients underwent an FDA-approved study of laser-assisted liposuction in five plastic surgery centers. The YAG laser fiber is contained within the cannula and shears off the fat cleanly and coagulates blood vessels as the fat is drawn into the cannula. The drop in hemoglobin was relatively modest after surgery. Patients were able to return to work at six days and to light exercise at seven days. Contralateral studies showed a slight benefit for the laser side at both one and eight weeks for ecchymosis, pain/discomfort, and edema. Lipocrit studies were inconsistent.

Key words: Liposuction—YAG laser—Hemostasis

Liposuction has become well accepted as a safe and effective outpatient procedure for body contouring. Blood loss remains a major concern in liposuction and inevitably occurs to some degree in all cases. In fact, many patients are requested to donate at least one autologous unit of blood for their surgery and most surgeons limit liposuction to 2000 g of tissue because of excessive blood loss.

In 1991, under an FDA-approved protocol, a study was undertaken to determine whether the addition of a laser fiber inside a standard liposuction cannula would diminish blood loss and thus improve postoperative recovery. This procedure, termed Laser-Assisted Liposuction (LAL), has been carried out and we report our findings here.

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Technique

The YAG laser is used with 40 W of power, a pulse duration of 0.2 s, and an interval between pulses of 0.2 s. A special single-holed, 4- or 6-mm cannula is used with a side channel that emits a 600-μ fiber with surround cladding that allows a continuous saline infusion to cool the tip. The fiber is threaded toward the end of the cannula, until it lies 2 mm proximal to the single hole so the laser beam is directed across the hole. The continuous infusion pump allows 400–700 cc of normal saline irrigation to cool the tip of the laser fiber.

Sites for liposuction are prepared in the usual manner, with infusion of marcaine/epinephrine diluted in 500 cc of normal saline and injected 20 minutes prior to the procedure. During liposuction, the operator inserts the cannula, institutes the suction, and then depresses the laser foot pedal. Thus, the negative suction draws the fat globule into the hole of the cannula, where the laser beam shears it off bloodlessly (Fig. 1). The fat appears as a light yellow emulsification. The operator moves his arm back and forth in a slow, easy manner rather than in faster, more violent back and forth strokes. This avoids the usual ripping and tearing of the fat by the back and forth action of the operator during standard liposuction. The procedure provides several benefits. The surgeon expends much less arm motion since the laser beam shears off the fat resulting in a slower and smoother arm activity. The patient benefits by a markedly less traumatic and less hemorrhagic procedure resulting in diminished pain, discomfort, bruising, and swelling. As a side benefit, more fat volume can be removed and need for blood replacement is decreased.

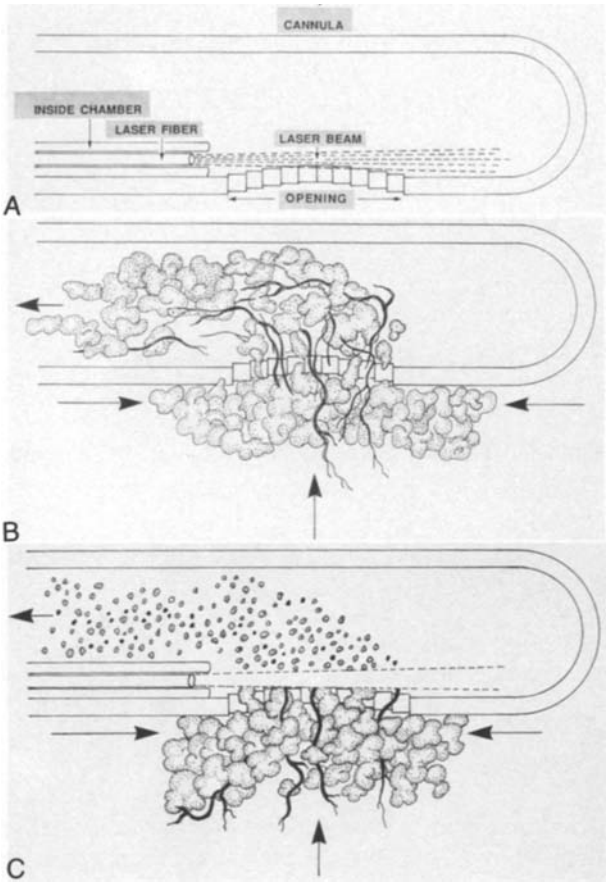

Fig. 1(A) Schematic of laser liposuction cannula. Laser beam is enclosed inside cannula. **(B)** Negative suction draws fat and small blood vessels into cannula. **(C)** Laser beam shears off fat precisely and bloodlessly and fat emulsifies and then is drawn out by suction

Table 1. Patient and treatment data

51 Patients:
38 female
13 male
DBA (14), SR (12), JH (10), BA (8), FP (7)
Age:
0–29 (5)
30–49 (37)
>50 (9)
Previous liposuction: 6/51
Outpatient: 49/51
Cannula: 6 mm (38), 4 mm (14), both (3)

Table 2. Amount of tissue volume and number of patients

Volume (cc)	Number
0–500	25
500–1000	12
1000–2000	9
>2000	
5100	1
3000	1

Table 3. Results of hemoglobin studies

Avereage preop HGB: 13.5
Postop HGB at 1 week:
drop 0–0.5: 14 patients
0.6–1.0: 9 patients
1.0–1.5: 5 patients
>1.5: 12 patients
Three increased by 3.9, 0.2, 0.1

Study Data

The FDA-supervised multicenter study began in 1991 and concluded in November 1992. Five board-certified plastic surgeons participated in the study and enrolled 51 patients (Table 1). There were 38 females and 13 males with an average age of 35.8 (range: 19–64). Six of the 51 patients had previous liposuction and 49 of the 51 patients were outpatients. Various preinjection solutions were used (most commonly saline with xylocaine and epinephrine), although one surgeon did not use any preinjection. The amount of tissue volume as rated is summarized in Table 2; 46 patients had <2000 g of tissue removed. The length of time for the surgery was not significantly increased although the presurgical assembly of the equipment was somewhat time-consuming. Table 3 details the blood loss assessed by hemoglobin measurements prior to and one week following the procedure. A drop in hemoglobin of 1–1.5 g was observed in 28 of 43 patients, with 12 patients' hemoglobin dropping over 1.5 g and 3 patients demonstrating a rise in hemoglobin. The patients returned to work at six days on average, light exercise at seven days, and vigorous exercise at 16 days on average (Figs. 2–3).

Fifteen patients underwent laser-assisted liposuction on one side and conventional liposuction on the opposite side (Table 4). There was no scarring, infection, or hypopigmentation, and there was no difference in paresthesias and skin irregularities between the two sides. Pain and discomfort were evaluated at one week and eight weeks. At one week, 10 of 15 patients had none or mild problems on the laser side while only 6 of 15 patients had none or mild pain/discomfort on the conventional side. At eight weeks there was no pain/discomfort on the laser side while 2 patients still complained of mild pain/discomfort on the conventional side. At one week, ecchymosis was mild in 9 patients and moderate in 2 patients on the laser side and mild in 3 cases and moderate in 9 cases on the conventional side. No patients had ecchymosis at eight weeks on the laser side while one patient still had

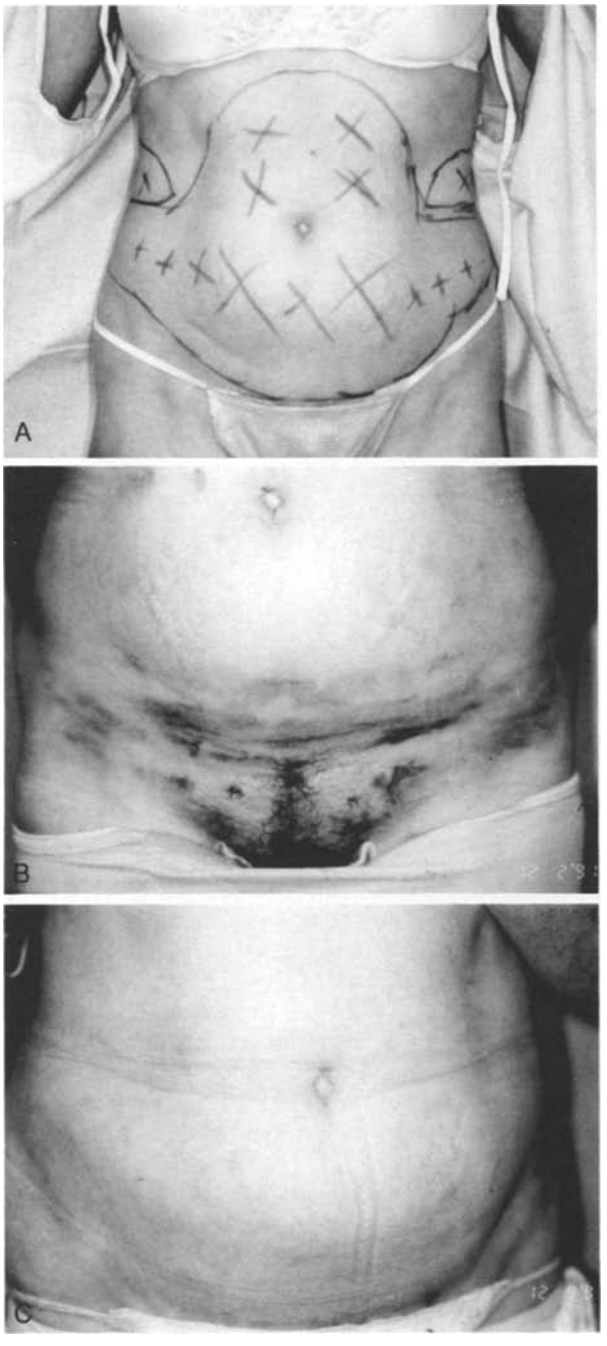

Fig. 2(A) Preoperative appearance of abdomen. **(B)** Appearance of patient in **A** 6 days following laser liposuction of the abdomen. Note minor bruising and swelling in the pubic area only. **(C)** Appearance 13 days following laser liposuction. All bruising and swelling is gone

ecchymosis on the conventional side at eight weeks. Edema was judged none (2), mild (7), moderate (3), severe (3) at one week on the laser side and none (2), mild (4), and moderate (9) on the conventional side. Only one patient still had mild edema at eight weeks on the laser side while 3 still demonstrated mild edema on the conventional side. While these results are not

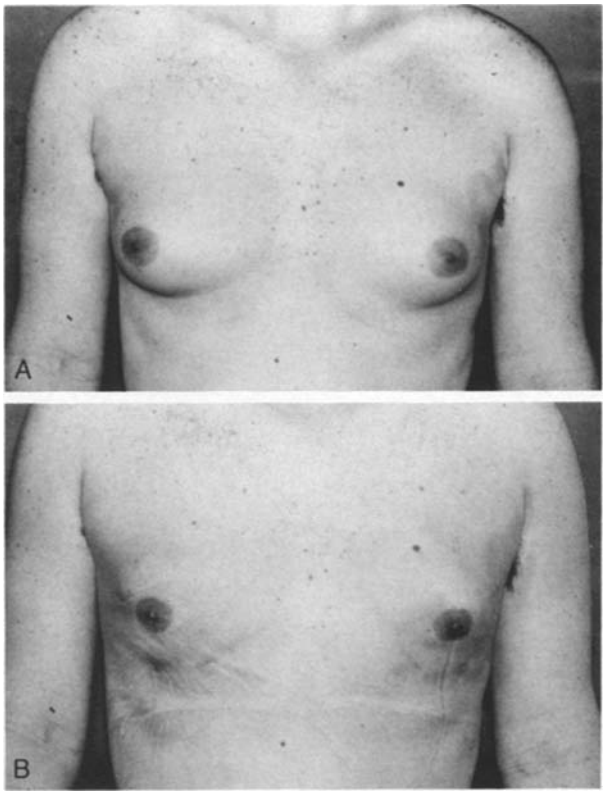

Fig. 3(A) Preoperative view of gynecomastia. **(B)** Results 7 days following laser liposuction

statistically significant, they do show a slight preference for improved results on the laser side (Fig. 4–6).

Lipocrit values were performed on many patients. Results were inconsistent and did not support clinical impressions. Lipocrits averaged 75% for the laser and conventional liposuction sides. In some cases, lipocrits of 90% were recorded for the laser side and 70% on the conventional side. Other cases demonstrated better lipocrits (80%) on the conventional side versus only 70% on the laser side. Lipocrit studies have long been known to be difficult and inconsistent due to sampling errors, settling of contents, and centrifuge difficulties.

Discussion

A potentially serious and dangerous drawback to suction lipectomy is the exact determination of blood loss. Resorting to only guessing or estimating, partially verified by a centrifuged lipocrit done after the procedure is over, does not allow precise fluid, colloid, and blood replacement for the safety of the patient. Mladick and Morris [12] suggested that blood in the bottle averaged about 30% of the total aspirate and that up to 50% more blood loss may be sequestered by third-space loss in the body. Grazer [7] took exception to this overgenerous estimate of blood loss and suggested

Table 4. Contralateral observations, 15 cases

	1 week		8 weeks	
	Laser	Conventional	Laser	Conventional
Pain/discomfort	3 none 7 mild 4 moderate 1 severe	2 none 4 mild 9 moderate	15 none	13 none 2 mild
Infection	15 none	15 none	15 none	15 none
Skin damage/irregularities	13 none 1 mild 1 moderate	13 none 2 moderate	11 none 2 mild 2 moderate	12 none 2 mild 1 moderate
Paresthesis	6 none 8 mild 1 moderate	6 none 7 mild 2 moderate	14 none 1 mild	14 none 1 mild
Ecchymosis	9 mild 2 moderate 4 severe	3 mild 12 moderate	15 none	14 none 1 mild
Edema	2 none 7 mild 3 moderate 3 severe	2 none 4 mild 9 moderate	14 none 1 mild	12 none 3 mild
Scarring	15 none	15 none	15 none	15 none
Hyperpigmentation	15 none	15 none	15 none	15 none

that a figure of 10%–15% of the material aspirated is blood. Courtiss [3] observed that "calculation of the volume of blood loss was difficult" and offered one-quarter of the tissue removed as a rule of thumb to estimate blood loss. Gargan and Courtiss [6] suggested that up to one third of the aspirate is blood. Courtiss [4] recently has studied the effect of preinjection with saline and various saline/epinephrine combinations. Results were evaluated on a computerized suction aspirator first described by Apfelberg et al. [1]. He reported blood loss of 34%–44% in his group of patients, depending on the volume and composition of the preinjection solution. Mladick [13] took issue with these figures claiming an average blood loss of 28.3% in a series of 200 patients.

The recent evolution of syringe liposculpture accompanied by the "tumescent" method of injection by Klein [8] has claimed reduced blood loss. Lewis [9] studied six patients undergoing bilateral procedures, one side conventional and the other side syringed liposculpture. Clinical examination done in a double-blind manner and differential measurement of blood loss in the specimen collection both demonstrated diminished bruising and swelling on the syringe side as well as an average of 2%–4% less blood in the aspirate. Mandel [11] evaluated ten patients who underwent liposuction by syringe or by machine. He noted that the average drop in hemoglobin went from 14.2 to 11.5 in the machine group, while the syringe group's average hemoglobin drop was 14.2 to 12.1; both procedures used the same preinjection solution. Chrisman and Coleman [2] claimed the tumescent technique, prechilling areas for liposuction, and injection of chilled solution should produce no more than 10% blood loss in females and 15% in males. Lillis [10] has demonstrated that serum lidocaine levels are not dangerously high even with large-volume tumescent injection solutions.

Since its development and introduction by Dressel [5] in 1990, laser-assisted liposuction has been done on 51 patients under a FDA-approved protocol. Disadvantages attributed to the procedure were mainly technical in nature. The equipment is slightly cumbersome and awkward and requires some experience in laser use. Safety glasses are necessary and the laser is relatively noisy in the operating room. The fiber is cooled by a constant infusion of normal saline which requires use of an additional piece of equipment (constant infusion pump) in the operating room which occasionally malfunctions.

Advantages of LAL to the surgeon include greater ease of manual operation with less vigorous arm motion and, subsequently, less arm and shoulder fatigue since the laser melts and emulsifies the fat allowing for easier aspiration. The potential ability to remove greater volumes of fat with less risk of blood loss and need for blood replacement is also a benefit. There may be a clear marketing or practice enhancement factor because many patients might choose a surgeon who offers the laser procedure rather than the standard procedure.

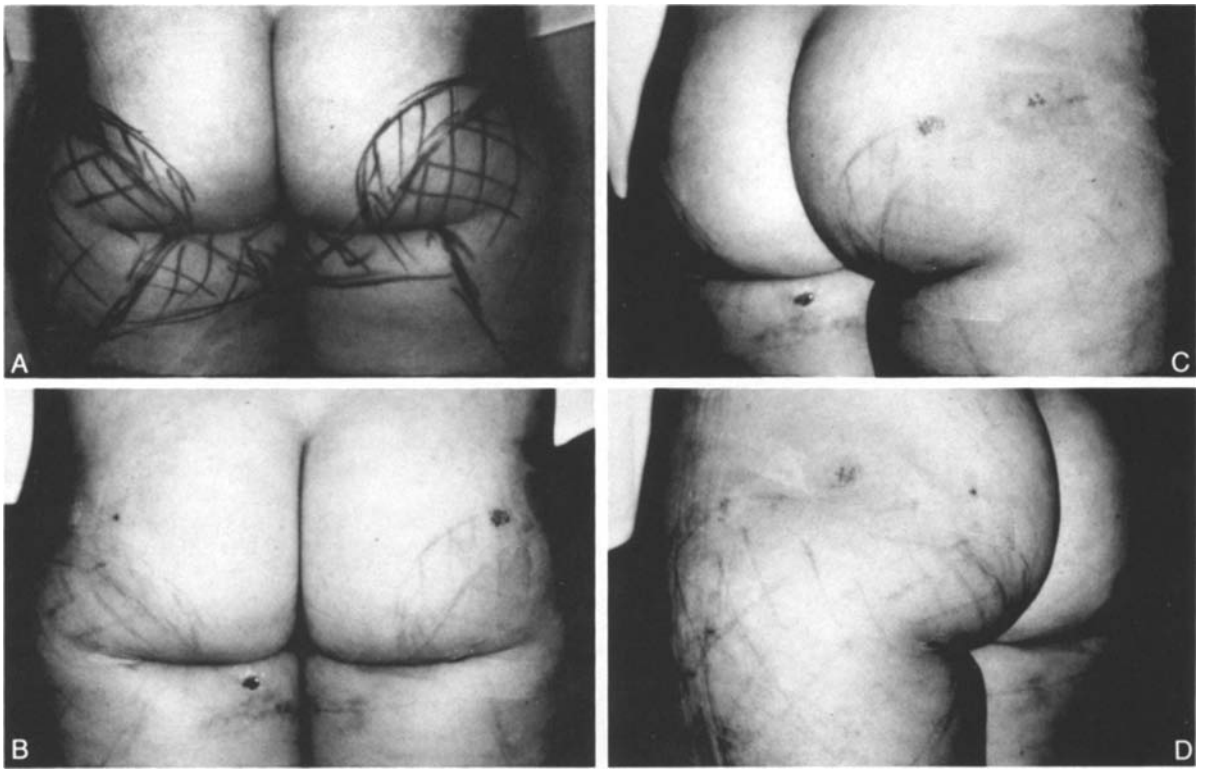

Fig. 4(A) Preoperative view of lipodystrophy of thigh and buttock. **(B)** Appearance 5 days after laser liposuction on right and standard liposuction on left. Note greater bruising and swelling on left **(C)** Close up 5 days postoperative of the right thigh done with the laser. Note minimal bruising and swelling. **(D)** Closeup 5 days postoperative of left thigh done with standard liposuction demonstrating greater bruising and swelling than laser side

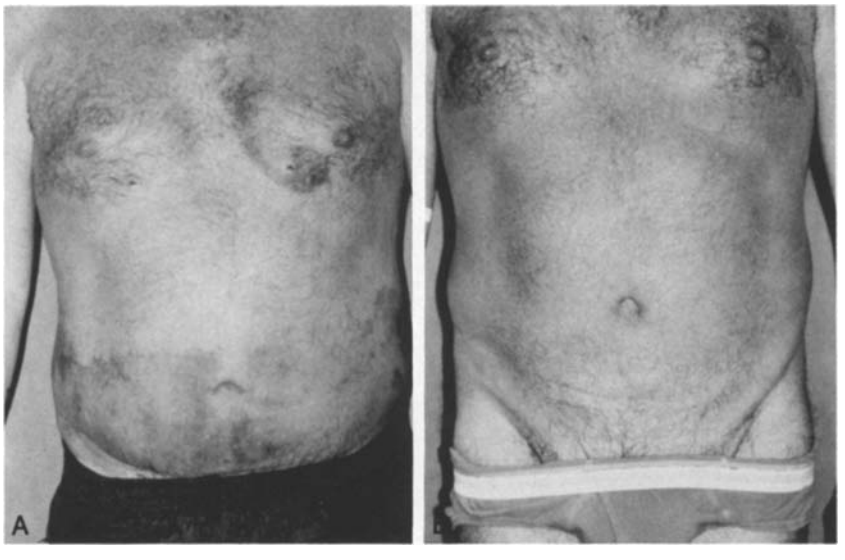

Fig. 5(A) Preoperative lipodystrophy abdomen. **(B)** One week postoperative view of left side of abdomen was done by laser and right side was done by conventional method. Note less bruising on laser side

Conclusions

The results of this study did not demonstrate a clear and significant benefit of laser liposuction over conventional liposuction. The equipment was cumbersome to use, and several failures in the procedure occurred due to problems with either laser fibers or the continuous infusion saline pump. Although the surgeons subjectively felt that there might be an improvement of laser liposuction results over those of conventional procedures, this was not borne out by either lipocrit studies or careful bilateral clinical observa-

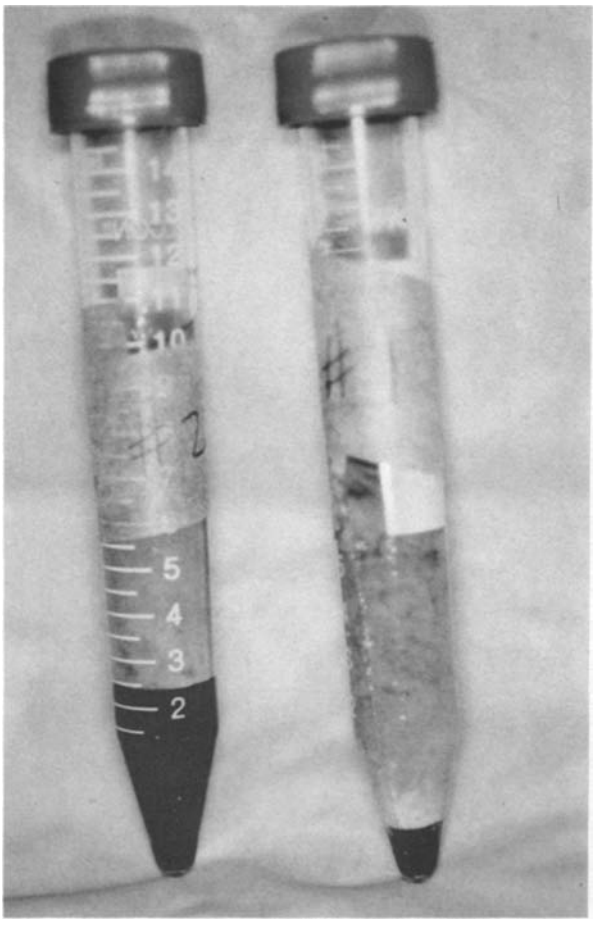

Fig. 6. Demonstration of lipocrit differential observed on a patient with laser liposuction on the right (#1) (12.1% blood) and regular liposuction on left (#2) (29.2% blood)

tions. Laser-assisted liposuction has not been approved by the FDA and it is unlikely that the sponsoring laser company will pursue further investigation of the procedure at this time. Therefore, although laser-assisted liposuction initially showed promise in improving results of liposuction, clinical benefits were not positive enough to warrant further studies to gain FDA approval at this time.

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