

## Evaluation of Blood-Loss in Laser-Assisted Liposuction\*

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### ABSTRACT

The use of a laser to assist liposuction has potential benefits including destruction of fat cells, reduction of blood loss, and better skin retraction. In order to objectively evaluate the external blood loss with traditional and laser-assisted liposuction, 14 female cases were studied. They all suffered from localized obesity of the trochanteric and/or the gluteal regions. The left side of the patient was treated by traditional liposuction while in the right side, laser-assisted liposuction was applied. Blood content in the aspirates from each side were measured and compared. A blood-loss reduction of 26.8% was noted when laser-assisted liposuction was used.

### INTRODUCTION

Since its introduction in 1977 by Yves-Gerard Illouz, liposuction gained wide popularity in the plastic surgical field. Currently, it is the most-commonly performed cosmetic surgical procedure. Several modification of the original technique were introduced to reduce the complications and to improve the outcome [1-3]. Injecting diluted solution containing hyaluronidase was used to facilitate the suction and to reduce bleeding. Diluted epinephrine solutions were also used to produce vasoconstriction and reduce the blood loss in the aspirate. The tumescent technique uses large volumes of saline or lactated ringer's solution with diluted epinephrine and lidocaine. Using this technique, blood-loss was markedly-reduced from an average of 200ml. (with the original dry technique) to 20ml. per litre of fat aspirate. Local anaesthesia was also possible with this technique. Disadvantages of the tumescent liposuction include: Lidocaine toxicity, volume overload and epinephrine toxicity [4,5]. The use of fine cannulas reduced the incidence of irregularities and opened the way to superficial liposuction of

the structural fat [6]. The syringe liposuction allowed the concomitant use of fat grafting with liposuction to treat depressed areas [7,8]. In the ultrasonically-assisted liposuction, the emulsified fat was easily aspirated with weaker suction vacuum. Difficult fibrous areas were also better handled by this technique. Blood-loss however was not reduced and seromas occurred in a higher percentage than traditional liposuction [9,10]. External ultrasound and external low-power lasers were also used prior to liposuction in difficult areas [6,11]. Power-assisted liposuction uses a mechanically-driven mechanism to produce forward and backward movements of the aspiration cannula. The technique lessens the straining on the surgeons' arms and allows better suction in fibrous areas [12].

The use of laser in liposuction procedures was introduced by Dressel in 1990. It was applied in a multi-centre study by Apfelberg in 1994. Both could demonstrate that fat was aspirated by less effort, and that suctioned areas suffered less bruising when laser liposuction was applied compared to traditional liposuction. However, histologic studies were not performed and the complexity of the machinery led to the fact that they abandoned the technique [13,14]. Starting of 2002 several histologic reports were published that delineated the effect of laser on adipose tissues. Disruption of cell membrane of adipocytes was demonstrated using low-power lasers; while destruction of cells (lipolysis) occurred with higher powers. Blood vessels were coagulated in areas of laser application which would result in a reduced bleeding in the aspirate, as well as a diminution of ecchymosis. Collagen deposition in the subdermal layer was also noted which could lead to better skin tightening [15-18]. Using Nd:YAG laser in liposuction, several clinical reports were published [19-22]. Laser energy was applied via a percutaneous fiberoptic cable to fat deposits. Laser was then activated to perform

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lipolysis. In very small fat deposits, the technique could end here by leaving the treated fatty tissue to be naturally absorbed (interstitial laser lipolysis). For larger areas, liposuction was applied after laser lipolysis (laser-assisted liposuction).

In laser-assisted liposuction, several authors noted that the fatty aspirate contained less blood than traditional liposuction. However, no objective evaluation of the percent of blood loss reduction was performed. The aim of the current work is to compare traditional and laser-assisted liposuction concerning the amount of blood in the aspirate.

### PATIENTS AND METHODS

Fourteen female volunteers were included in the current study which dated from March 2007 till January 2008. Their ages ranged from 20 to 40 years (mean 28.5 years). All cases suffered from symmetrical localized obesity of the trochanteric and/or the gluteal regions. They were all in good general condition with normal routine preoperative laboratory tests, and had no previous surgeries done to the areas to be treated. The left side of the body was treated by conventional liposuction while the right side was treated by laser-assisted liposuction.

Epidural anaesthesia with I.V. sedation was used in all cases. Diluted epinephrine solution (1: 500,000) was injected in each side based on the anticipated amount of liposuction in a one to one ratio. The volumes injected were identical in both sides. Infiltration and liposuction was performed by the same surgeon in each individual case, using the same infiltration cannula (1.5mm. diameter) and the same liposuction cannula (60ml. syringe type, 3mm. diameter and, 3 holes tip). The interstitial laser application was done by another surgeon while the first one performed liposuction on the left side (traditional liposuction side). A quasi-continuous Nd:YAG laser (Fotona SP2, Fotona Laser Company, Slovenia) was operated at 12W. of power (a train of 100Usec. pulse-duration and 70Hz. of pulse repetition). The laser was delivered by a 400Um. optical fibre, using a special 25cm. long cannula. The cannula (containing the fibre) was introduced in a percutaneous route. A gentle forward and backward movement was used to deliver the laser to the fat deposits in a method similar to performing traditional liposuction. An average of 2000 Joules was applied to each 100gm. of fat to be treated.

Injection of the left side was done first followed by the right side. Liposuction of the left side was

started 20 minutes after the completion of the injection of that side. Interstitial laser application was done to the right side when 20 minutes have elapsed from the completion of the injection (usually during the liposuction of the left side by the first surgeon). After the completion of the liposuction of the left side, the fat was collected in a separate container and the amount noted. The right side was then treated by liposuction after the application of the interstitial laser. The same amount of fat was suctioned from the right side (as the left side) and was also collected in a separate container (Fig. 1). Normal saline was added to each fat container to wash the blood in the supernatant fat and to equalize the volume of the infranatant fluid. Samples were collected from the diluted infranatant fluid and the haemoglobin concentration was measured.

Since both infranatant fluid volumes were equal after dilution, and the supernatant fat was clear of blood staining, then the haemoglobin concentration of the infranatant fluid reflects the relative amount of blood loss in each side of the patient. The percentage of blood-loss reduction in the right side (laser side)-compared to the left side (traditional side)-was calculated using the following equation:

$$\frac{\text{Haemoglobin concentration in the left side} - \text{Haemoglobin concentration in the right side}}{\text{Haemoglobin concentration in the left side}} \times 100$$

Patients were instructed to wear a compression garment for one month. They were followed-up weekly for the first month postoperatively, and every two weeks for an additional period of two months.

### RESULTS

Out of the 14 cases included in the current study, liposuction was performed on the trochanters in 3 cases and on the gluteal regions in 2 cases. The remaining 9 cases had treatment for both trochanteric and gluteal regions. The total volume of liposuction performed on one side of the patient ranged from 500 to 1600ml. In 12 cases the aspirates of the laser side had less blood content than that of the traditional side. Two cases had slightly more blood in the aspirate of the laser side. The percentage of blood-loss reduction with laser-assisted liposuction-ranged from +58.6% to -4.3%. (the minus sign indicates that the laser side had more bleeding than the traditional side) (Table 1). The mean blood-loss reduction with laser-assisted liposuction was 26.8%.

There were no major complications in all the cases (laser and traditional side). In addition, no complications or side effects were noted in relation to the laser application. Aspiration of fat from the laser-treated side was easier to perform, and fewer strokes of the liposuction cannula were needed to fill the 60ml. syringe (compared to the traditional liposuction side). The majority of the patients noticed less pain in the laser-treated side. In addition, less ecchymosis and a more even skin retraction was noted in the majority of the cases on the laser-treated side (FigS. 2,3). However, no objective evaluation method was used to record and evaluate these findings.



Fig. (1): Aspirates from the traditional liposuction side (left) and from the laser-assisted liposuction side (right).

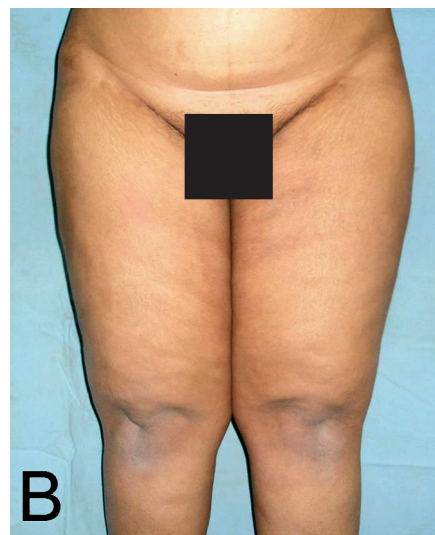


Fig. (2): Case number 3: (A) preoperative, (B) postoperative view 6 weeks after liposuction of the trochanteric and the gluteal regions. The left side of the patient was done with traditional liposuction, while the right side was treated by laser-assisted liposuction.



Fig. (3): Case number 3: Postoperative view (6 weeks) of the trochanteric region (A) after traditional liposuction and (B) after laser-assisted liposuction. Note the better skin retraction and the complete disappearance of the bruising in (B) compared to (A).

Table (1): Haemoglobin concentration (gm./dl.) in the diluted infranatant fluid of left side (traditional liposuction) and the right side (laser-assisted liposuction).

Case	Age	Areas treated	Volume of injection/ side (cm <sup>3</sup> )	Volume of suction/ side (cm <sup>3</sup> )	Volume of diluted infranatant fluid/ side (cm <sup>3</sup> )	Hb. % left side (traditional) (gm./dl.)	Hb. % right side (laser) (gm./dl.)	% Reduction in blood loss
1	20	Trochanters	600	720	400	0.73	0.41	43.8
2	31	Gluteal + Trochanters	1200	1500	700	1.14	0.76	33.3
3	23	Gluteal + Trochanters	1000	1250	750	0.92	0.63	31.5
4	26	Gluteal + Trochanters	700	850	450	0.69	0.72	- 4.3
5	29	Gluteal	550	600	300	0.83	0.4	51.8
6	36	Gluteal + Trochanters	1450	1600	700	1.21	0.86	28.9
7	29	Gluteal + Trochanters	1200	1100	550	0.62	0.45	27.4
8	32	Trochanters	500	650	275	1.07	1.11	- 3.7
9	20	Gluteal + Trochanters	1150	1400	600	1.62	0.67	58.6
10	27	Gluteal	850	1000	350	0.73	0.66	9.5
11	34	Trochanters	400	500	200	1.16	0.86	25.8
12	40	Gluteal + Trochanters	1300	1200	500	0.86	0.77	10.4
13	20	Gluteal + Trochanters	1000	1250	450	1.2	0.72	40
14	32	Gluteal + Trochanters	900	1250	500	0.81	0.62	23.4

## DISCUSSION

Laser-assisted liposuction was first investigated by Apfelberg [14]. Under an FDA approved protocol, 51 patients were treated by this technique. At the conclusion of the study the FDA stated that clear and definite advantages could not be demonstrated and the technique of laser-assisted liposuction was not approved. This statement from the FDA has discouraged investigations in that field for about a decade. In the original technique of laser-assisted liposuction-investigated by the FDA, a fiber was introduced in the liposuction cannula and the Nd:YAG laser was activated on the fat that was already suctioned at the cannula opening. In fact this original technique does not represent an effect of laser of adipose tissue but an effect of laser on already-suctioned fat. Another disadvantage of this original technique is the fact that the fiber that was present inside the cannula-led to heating of the cannula and the need to cool the cannula by a continuous fluid infusion. This complicated the technique and several failures of the pump mechanism were cumbersome to the operators. This fact was taken into consideration by the FDA in its final judgment on laser-assisted liposuction. Despite these disadvantages, the results of the multicenter

study conducted by Apfelberg in 1994 showed less bleeding in the aspirate, less ecchymosis and swelling postoperatively and, easier suction of the fat when laser-assisted liposuction was used. However, no objective numerical results were published on the percentage of blood-loss reduction when laser-assisted liposuction was used. In addition, the study did not include any histological examination of the laser-injured fat.

Since 2002 several reports [15-17] appeared in the literature describing the effects of laser on adipose tissue. Neira et al. [15], studied the effects low-level diode laser; while Badin et al., in the same year [17] reported the effect of the Nd:YAG laser on fatty tissues. Several beneficial effects were demonstrated including: Destruction of adipocytes, coagulation of blood vessels, collagen deposition and, improved tissue healing. The technique of interstitial laser lipolysis was thus developed using the Nd:YAG laser. It was different from the original technique (used by Apfelberg) in the fact that the laser was applied directly to the fatty tissue that needed modification via a fiber optic cable. After irradiation of the fatty tissue, the fat was suctioned (laser-assisted liposuction). Badin et al. [19] reported the results of this technique on

245 patients. They noticed less bleeding than conventional liposuction but did not objectively evaluate the percent. Their conclusion was that the tissue tightening that resulted from collagen deposition by the laser-led to a better outcome. The same technique was used by Goldman [22] on 82 cases of submental lipodystrophy. He also concluded that the aspirates contained less blood and that the skin retraction was better than conventional liposuction. In both studies the authors did not compare the traditional and the laser-assisted liposuctions on the same patient, nor did they objectively evaluate the amount of reduction in the blood loss when the laser was used. Prado et al. [20] conducted a study comparing laser-assisted and traditional liposuction in 25 cases. Traditional liposuction was used on one side and a similar region was treated by laser-assisted liposuction of the contralateral side. They stated that the laser-assisted liposuction was only beneficial in having less pain, and having higher triglycerides and DNA cellular membrane traces in the aspirate.

In contrast to the work of Badin and Goldman, the current study compared the blood-loss in the aspirates of the two liposuction techniques using both side of the same case. All other factors (volume of infiltration, volume of suction, operator and instrumentation) were controlled so that the only variable was the laser application. Although Prado et al., used a similar protocole of comparison between the traditional and the laser-assisted liposuctions, yet they did not include the evaluation of the blood-loss in the aspirates. Using a controlled comparative study, the current work showed that by applying a 12W Nd:YAG laser interstitially prior to liposuction, the external blood-loss could be reduced by approximately 27%. In both Badin's and Goldman's work, the swelling was less and the skin had a better retraction, when the laser was used. On the other hand, Prado et al., could not detect a significant difference in the cosmetic outcome of both techniques. In the current study, better skin retraction and faster disappearance of the bruising, was generally observed on the laser-assisted side. However, no objective evaluation method was used to document these findings.

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