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Aesthetic Plastic Surgery

Comparison of Power Water – Assisted and Traditional Liposuction: A Prospective Randomized Trial of Postoperative Pain

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Abstract.
Background: Postoperative pain has always been underestimated by the majority of plastic surgeons. A prospective randomized trial compared power water-assisted liposuction with the traditional tumescent technique.
Methods: All patients with a body mass index (BMI) of 25 to 30 and excessive localized pathologic fat were recruited. Exclusion criteria specified a BMI greater than 30 or redundant anelastic skin. Patients were randomly assigned to power water-assisted or traditional liposuction.
Results: From September 2005 to December 2005, 60 patients were recruited and analyzed. For the study, 28 patients were randomized to traditional liposuction and 32 to power water-assisted liposuction. A significant difference in postoperative pain was observed ($p < 0.05$). After 4 days, 87% of the patients who underwent power water-assisted liposuction were completely pain free, as compared with 3.6% of those treated with traditional liposuction. Furthermore, ecchymosis was significantly less for the patients who underwent power-assisted liposuction ($p < 0.05$).
Conclusions: The study findings demonstrate that power water-assisted liposuction is an almost painless procedure that produces less tissue trauma than traditional liposuction.

Key words: Cosmetic surgery—High-pressure liposuction—Liposuction complications—Pain—Postoperative pain—Power water-assisted liposuction

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Since the early 1960s [8], liposuction has become the second most frequent aesthetic procedure in the United States, and its safety and efficacy have been proven in several articles. Over the years, many changes and innovations have increased indications and helped to avoid unfavorable postoperative sequelae such as seromas, hematomas, and thrombosis. In the beginning, it was essentially a dry technique [8], which subsequently evolved into wet, superwet, and tumescent liposuction [9]. Furthermore, Gasparotti [3] introduced the concept of superficial liposuction, and Zocchi [10] first presented the ultrasound-assisted technique. All these techniques introduced important results in terms of aesthetic outcome and postoperative sequelae.

Postoperative pain often has been underestimated by the majority of plastic surgeons and not considered an important factor. A recent study by Troilius [9] addressed this matter and found that 51.8% of patients required pain relief during the first postoperative hours, with 29% requiring pain relief on the first postoperative day. Furthermore, the medications used by 31.5% of these were considered strong (intravenous Tramadol or subcutaneous morphine).

Our study aimed to assess whether a new liposuction technique using a power water-assisted device (Bodyjet; Human Med, Schwerin, Germany) could be useful for decreasing postoperative pain without adversely affecting the aesthetic results. For this purpose, we conducted a prospective randomized trial comparing this technique with traditional tumescent liposuction.

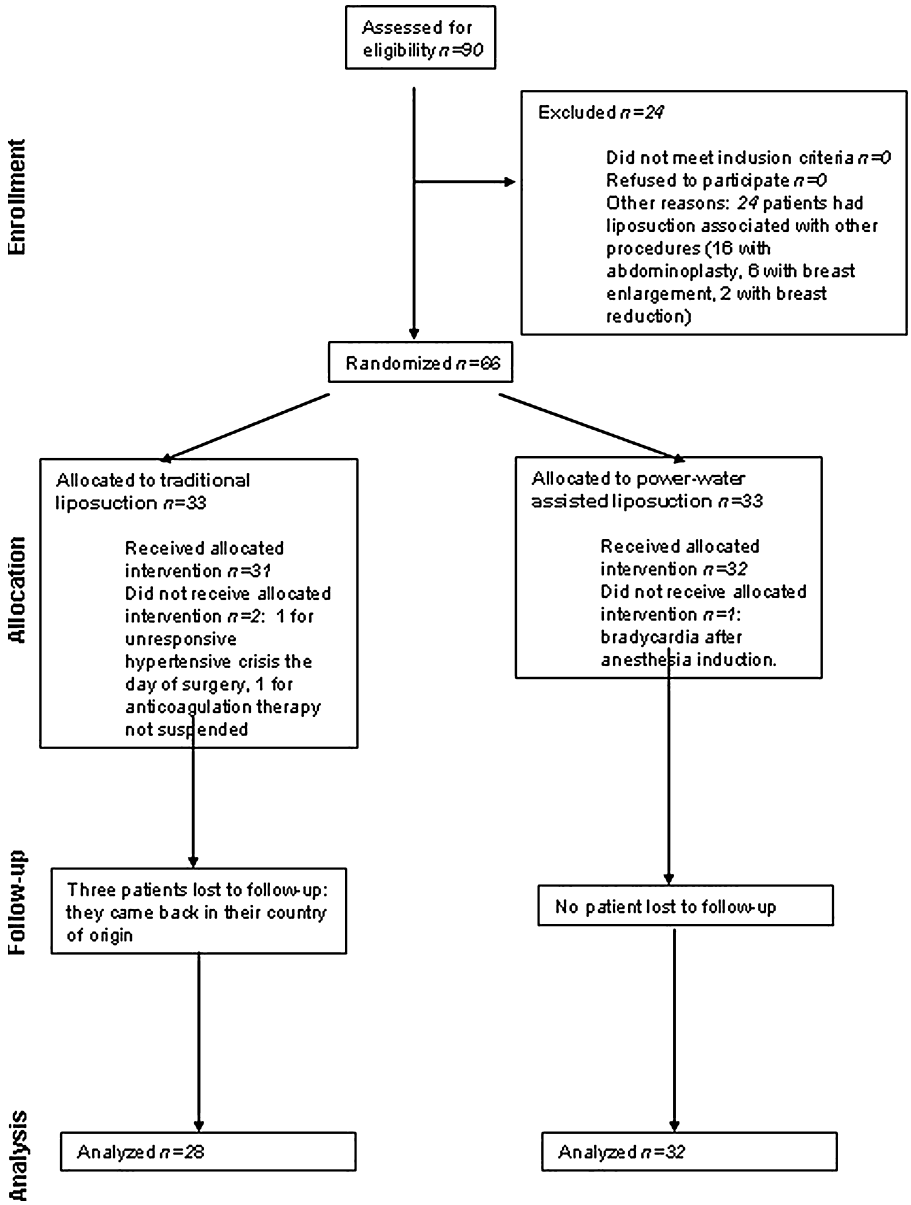

Fig. 1. Flow diagram showing the number of participants throughout each stage of the study.

Materials and Methods

The authors had no particular relationship with the power water-assisted device manufacturer (Schwerin, Germany). The eligibility criteria included all patients with a body mass index (BMI) of 25 to 30 with excessive pathologic fat located in the outer and inner thighs, knees, abdomen, flanks, chest, arm, ankles, chin, and buttocks. The exclusion criteria specified patients with a BMI exceeding 30 (morbid obesity) and those with redundant or anelastic skin (anticipating a bad aesthetic outcome). All patients underwent surgery at the Crown House Hospital. Follow-up data were gathered during outpatient visits at the surgical ambulatories and from phone interviews.

Preoperative Procedure

Accurate evaluation of patients was performed during preoperative visits including general history, physical examination, specific examination of body fat and skin elasticity/redundancy, BMI measurements, and assessment of associated pathologies. Oral anticoagulants, when present, were discontinued 7 days before surgery. The National Institute for Clinical Excellence (NICE) guidelines were adopted for preoperative testing [5]. Briefly, preoperative examinations were not necessary if the patient did not report any particular disease (American Society of Anaesthesiologists [ASA] score of 1) and the estimated amount of fat removed did not exceed 2,000

Table 1. Demographics and clinical characteristics of the patients and characteristics of the surgical operations

	Traditional liposuction n (range)	Power water–assisted liposuction n (range)	Test used	*p* Value
No. of subjects	28	32		
Age (years)	32.5 (20–51)	30.3 (19–47)	Student's *t*	NS (0.16)
Male sex	8	5	χ^2	NS (0.22)
Associated diseases	—	—		
Operating time (min.)	63 (34–80)	54 (20–80)	Student's *t*	*<0.05*
Fat removed (ml)	2,782 (900–5,000)	2,356 (150–4,000)	Student's *t*	NS (0.12)
Outer–inner thighs	13	9	χ^2	NS (0.14)
Knees	5	2	Fisher's exact	NS (0.16)
Upper–lower abdomen	13	19	χ^2	NS (0.32)
Flanks	14	13	χ^2	NS (0.47)
Chest	3	2	Fisher's exact	NS (0.53)
Arm	1	—	Fisher's exact	NS (0.28)
Ankles	—	1	Fisher's exact	NS (0.35)
Chin	—	2	Fisher's exact	NS (0.18)
Buttock	—	1	Fisher's exact	NS (0.35)

NS, not significant.

Table 2. Measured values of pain and ecchymosis

	Pain: VAS score Mean (range)		Pain: number of analgesics Mean (range)		Ecchymosis: VAS score Mean (range)	
	Traditional	Power water-assisted	Traditional	Power water-assisted	Traditional	Power water-assisted
3 h	4.8 (1–7)	2.1 (0–4)	4.5 (1–8)	1.6 (0–6)	4 (3–6)	1.5 (0–3)
POD 1	4.9 (1–7)	2 (0–4)	4.7 (1–8)	1.6 (0–6)	3.9 (3–6)	1.5 (0–3)
POD 2	5.1 (1–7)	1.2 (0–3)	4.7 (1–8)	1.4 (0–6)	3.9 (2–6)	1.4 (0–3)
POD 3	4.5 (0–6)	1.1 (0–3)	4.6 (0–6)	1.0 (0–4)	4.1 (1–6)	1.2 (0–3)
POD 4	4.1 (0–6)	0.4 (0–3)	4.5 (0–6)	0.5 (0–4)	4.3 (1–6)	1.1 (0–3)
POD 5	3.8 (0–6)	0.3 (0–2)	3.6 (0–6)	0.3 (0–3)	4.3 (0–6)	0.9 (0–3)
POD 6	3.4 (0–5)	0.2 (0–1)	3.6 (0–4)	0.3 (0–2)	3.9 (0–5)	0.3 (0–2)
POD 7	2.9 (0–5)	0.2 (0–1)	2.8 (0–4)	0.2 (0–2)	3.1 (0–4)	0.2 (0–2)
POD 14	1.3 (0–3)	0	0.6 (0–2)	0	1.5 (0–3)	0

VAS, visual analog scale; POD, postoperative day.

ml. If the amount of fat to be removed was greater than 2,000 ml, a blood count was performed 30 min before the operation. Additionally, if the patient reported a medical condition relevant for the operation, specific examinations were performed [5].

Normally, no deep venous thrombosis prophylaxis was administered before surgery for patients who had less than 2,000 ml of fat removed. Those with greater amounts removed received low-molecular-weight heparin 2,000 U/day soon after the operation [7]. During the liposuction procedure, elastic stockings and mechanical calf-compression also were used to prevent deep venous thrombosis. One dose of cefuroxime (750 mg administered intravenously [IV]) or erythromycin for referred allergies [1 g IV]) was administered 10 to 30 min before the operation for infection prophylaxis. All patients underwent general anesthesia. We used a standard Klein solution (1 ml of adrenaline and 50 ml of lignocaine 1% diluted in 1,000 ml of normal saline) to infiltrate the fat tissue.

Main Differences Between Traditional Liposuction and Power Water-Assisted Bodyjet

The suction cannulas of power water-assisted liposuction are 15 and 25 cm long with a diameter of 3.5 to 5 mm. During traditional liposuction, 1,000 ml of Klein solution is introduced for every 1,000 ml of fat removed (1:1 ratio). Fat aspiration was performed 20 to 30 min after infiltration. During power water-assisted liposuction, 500 ml of Klein solution was administered for every 1,000 ml of fat removed (1:2 ratio), and aspiration usually was performed 5 to 10 min after the infiltration, according to the manufacturer's instructions and the authors' preliminary experience [1]. The anesthesia team usually infused 1,000 ml of normal saline during the operation. The difference between the total output of removed fat and the 1,000 ml of normal saline infused during surgery was reintroduced during the first postoperative hours with normal saline.

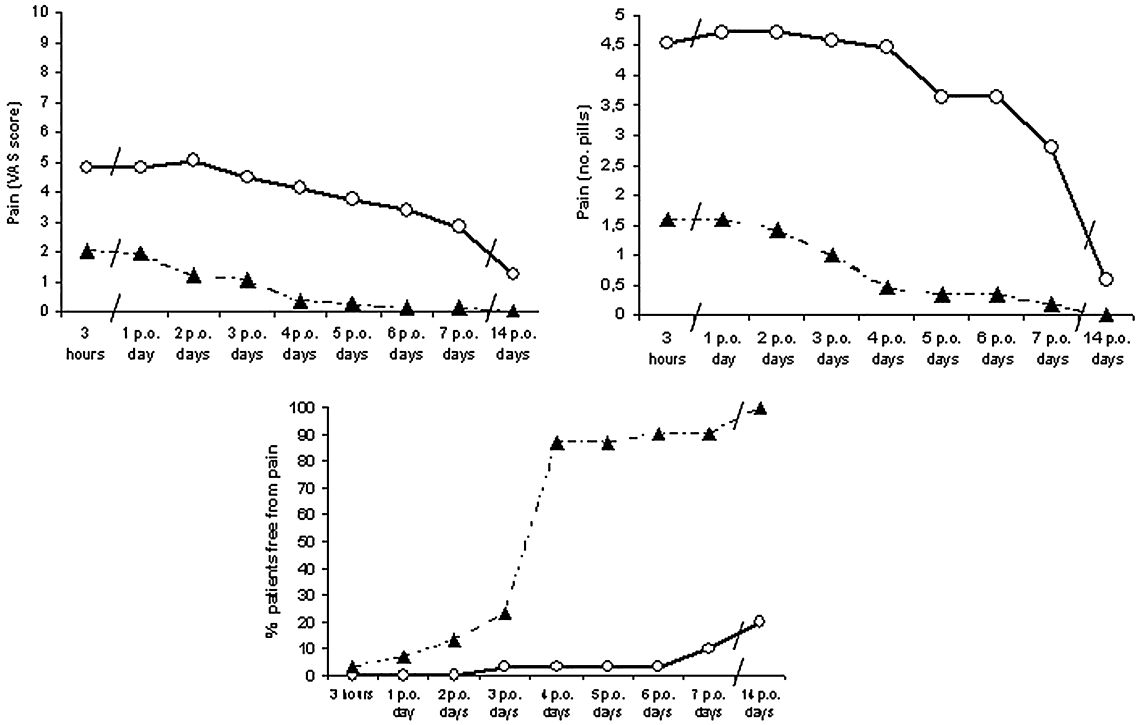

Fig. 2. Pain assessment. *Left upper panel:* Visual analog score (VAS). *Right upper panel:* Number of daily analgesic pills required. *Lower panel:* Percentage of patients completely free of pain. Circles represent traditional liposuction, and triangles represent power water–assisted liposuction.

Postoperative Care

A second dose of antibiotic was administered for patients who had more than 3,000 ml of fat removed. Co-codamol (paracetamol and codeine phosphate) usually was given every 4 to 6 h at the patient's request. A second dose of normal saline (50% of fat removed) was administered during the first 3 postoperative hours. Early mobilization was solicited 1 to 3 h after the operation.

Patients were discharged home 24 h after the operation. Elastic bands or garments were maintained for 6 weeks. Outpatient follow-up visits were planned at postoperative days 7, 30, and 90.

We hypothesized that power water-assisted liposuction could be more gentle and more respectful of anatomic structures (nerves and vessels) than traditional liposuction. For this reason, we established postoperative pain differences as the primary end points of the study. Pain was assessed with two different methods. The first method used a visual analogic scale (VAS), with patients asked to score their pain on a scale from 0 (absence of pain) to 10 (maximum pain experienced in their life) [4]. The second method involved the number of analgesic pills consumed daily by the patient, as recorded from medical charts. Patients were allowed to use only Co-codamol as analgesic medication.

Secondary parameters comprised measurements of intraoperative complications, possible adverse effects, postoperative ecchymosis, and aesthetic outcome. Ecchymosis was assessed by two independent plastic surgeons (C.V. and F.F.) asked to rate the extent of ecchymosis on a VAS scale of 0 (absence of ecchymosis) to 10 (ecchymosis in all operated areas). The aspirated fat was allowed to decant before the amount of fat removed using either method was assessed. Aesthetic results were scored on a VAS scale after 1 postoperative month by two plastic surgeons unaware of the study.

The sample size for the study was determined assuming a significance level (α) of 0.05, an effect size of 1 (minimal value of the VAS score or number of pills to be detected between groups), and a desired power of 80% for the experiment (0.80) [2]. Standard deviation of pain, measured using both VAS scores and the number of analgesic pills required daily, was assessed to be 1.3 in a previous study [2]. To account for all these parameters, the sample size was determined to be 28 patients for each group.

Participants were recruited during preoperative outpatient visits after assessment of eligibility. During the visits, two surgeons (A.A. and A.M.) explained the experimental nature of the trial, obtained signed informed consent, and randomly allocated patients to treatments. Randomization was carried

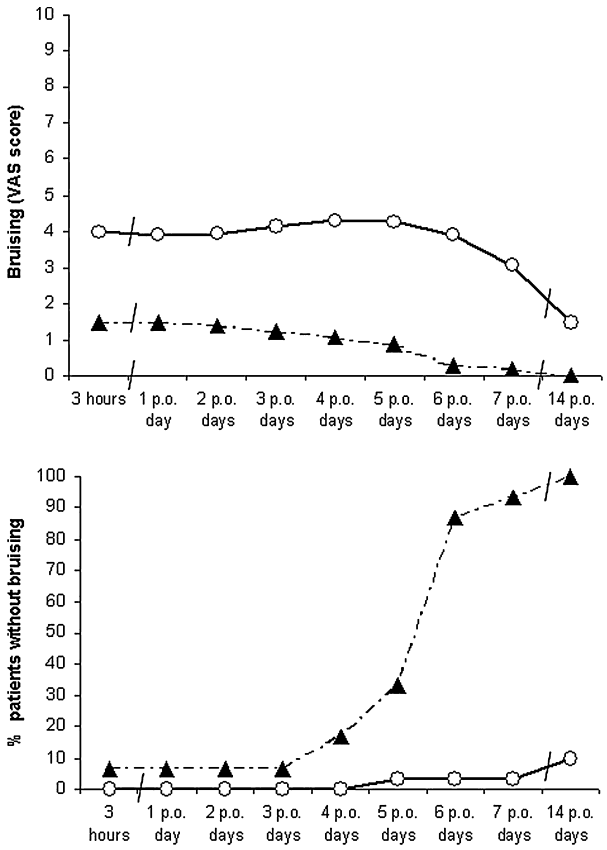

Fig. 3. Ecchymosis assessment. *Upper panel:* Visual analog score (VAS). *Lower panel:* Percentage of patients free of ecchymosis. Circles represent traditional liposuction, and triangles represent power water–assisted liposuction.

out using closed envelopes (two similar closed envelopes were presented to the patient containing papers indicating either traditional liposuction or power water-assisted liposuction). Both the patients and the surgeons assessing outcomes (G.G. and D.D.) were blinded to treatment. After data analysis, group allocation was revealed.

Statistical Analysis

All data analysis and calculation of sample size were performed using the Statistical Package for the Social Sciences Windows version 13.0 (SPSS, Chicago, IL, USA). The descriptive statistics used were mean, minimum, and maximum values. Pearson's product-moment correlation coefficient (r) was used to assess the relationship between continuous variables (operating time, amount of fat removed, pain—both VAS score and number of pills required, and ecchymosis) after confirmation of normal distribution. The Student's t test was used to compare continuous variables among groups of patients. Chi-square and Fisher's exact tests were used to compare nominal variables (sex and surgically treated areas). All p values less than 0.05 were considered significant.

Results

We followed CONSORT criteria for the development and description of the trial [6]. The flow of the participants through each stage of the trial is expressed in Fig. 1. The study began in September 2005 and ended in December 2005 with enrollment of the last patient. Follow-up assessment terminated in January 2006.

A total of 60 patients were analyzed: 28 for the traditional liposuction and 32 for the power water liposuction. Table 1 presents the demographics and clinical characteristics of the patients as well as the characteristics of the surgical operations. No significant differences existed between the two groups except for the operating time, which was longer for the traditional liposuction group than for the power water-assisted group ($p < 0.05$). For the chi-square test, the expected count for each cell was greater than 5. Aesthetic results were scored on the VAS scale at 8.5 (range 6–10) for the power water–assisted liposuction and 8.8 (range, 7–10) for the traditional liposuction. These differences were not significant ($p = 0.15$).

Comparison of the pain measurements showed a significant difference, with average values 4.8-fold lower for power water-assisted than for traditional liposuction ($p < 0.05$). Additionally, after 4 days, 87% (28/32) of the patients treated with power water-assisted liposuction were completely free of pain versus 3.6% (1/28) of those treated with traditional liposuction (Table 2, Fig. 2). Ecchymosis measurements also were significantly lower for the patients who underwent power water-assisted rather than traditional liposuction ($p < 0.05$) (Table 2, Figs. 3 and 4).

Analysis of operations throughout months demonstrated the surgeons' learning curve for the power water–assisted liposuction. The operating time for this technique was shorter at the end of the study, in contrast to the amount of fat removed, which was higher at the end. A linear correlation between pain (as determined by both VAS score and number of analgesic pills), ecchymosis, and the amount of fat removed existed for both techniques (Table 3). None of the recorded adverse events could be related directly to the procedure. One case of intraoperative bradycardia after anesthesia induction caused withdrawal of the surgery in the Bodyjet group. One hypertensive crisis not responding to treatment and a missed suspension of anticoagulants preoperatively caused a delay in the traditional liposuction procedure for two patients. These cases were not considered in the analysis. No early or late postoperative effects were recorded for either group.

Discussion

Power water–assisted liposuction is a recent technique that uses a high-pressure jet of water to detach adipose cells. The high-pressurize jet of water finds its

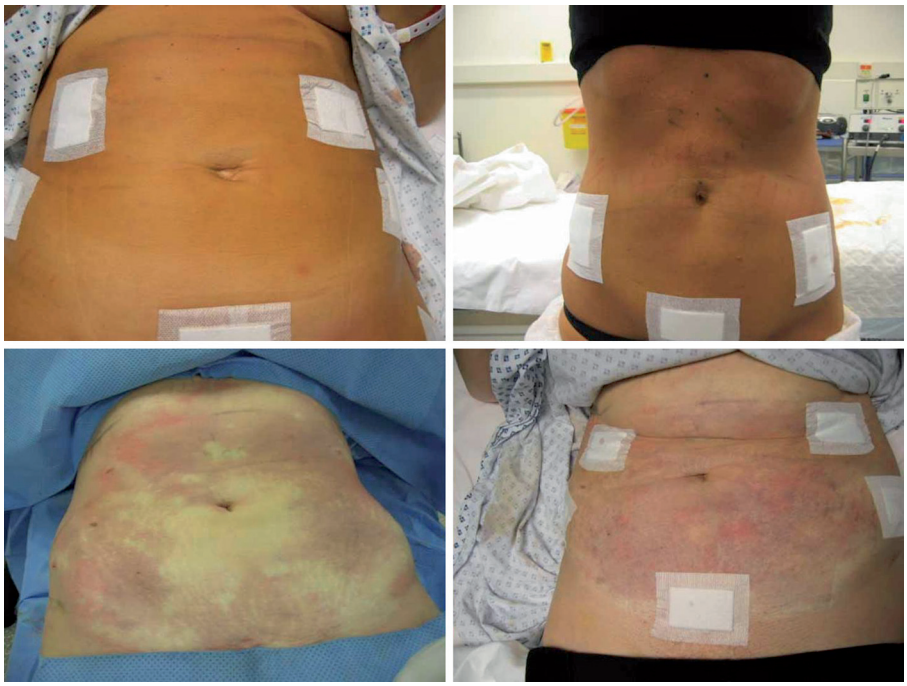

Fig. 4. Ecchymosis assessment. *Upper panels*: Power water–assisted liposuction patient (*left*: immediately after the operation; *right*: on postoperative day 1). *Lower panels*: traditional liposuction patient (*left*: immediately after the operation; *right*: on postoperative day 1).

Table 3. Correlation matrix of Pearson's index between pain or Ecchymosis and the amount of fat removed in both groups[a]

	Pearson's correlation index		
	Amount of fat removed vs pain (VAS)	Amount of fat removed vs pain (no. of pills)	Amount of fat removed vs brusing (VAS)
3 h	0.76	0.71	0.55
POD 1	0.76	0.75	0.54
POD 2	0.73	0.78	0.55
POD 3	0.73	0.74	0.55
POD 4	0.71	0.72	0.58
POD 5	0.75	0.65	0.59
POD 6	0.74	0.74	0.59
POD 7	0.79	0.74	0.73
POD 14	0.70	0.66	0.66

VAS, visual analog score; POD, postoperative day.
[a]All coefficients indicate significant association ($p < 0.05$).

natural way into tissues, possibly respecting, more than traditional liposuction, anatomic structures such as blood vessels and nerves. Our working hypothesis was to confirm this assumption by measuring postoperative pain and ecchymosis as indirect measures of nerve and vessel integrity, then comparing obtained values with those of the traditional liposuction.

The results showed that the hypothesis was completely fulfilled. All differences between power water–assisted and traditional liposuction in terms of pain (determined by both VAS score and number of analgesic pills required) were significant. The average values of these two parameters for the power water–assisted liposuction were 4.8 times lower than those for traditional liposuction. Ecchymosis also was minor for the power water–assisted liposuction, as compared with the traditional liposuction, and the differences were significant in every postoperative measurement (Table 2, Figs. 3 and 4). As shown in Fig. 3, both techniques showed a dramatic bruising reduction at postoperative day 5. However, the scores were significantly lower for the power water–assisted liposuction in every assessment during the first 5 postoperative days (Figs. 3 and 4). For all these reasons, the hypothesis that less trauma is produced for tissue nerves and blood vessels with power water–assisted liposuction than with traditional liposuction is consistent. With a fine jet of water that follows anatomic structures without damaging them, whose pressure can be adapted to different connective tissue structures, it is possible to selectively remove fat cells while sparing blood vessels and nerves.

Intraoperative events consisted of only one episode of bradycardia in the power water assisted-liposuction group, which happened during anesthesia induction before liposuction began. For this reason, we do not correlate this episode as derived from the technique. With respect to postoperative adverse events, none of the groups showed hypovolemia, hemorrhages, or infections. For this reason, power water–assisted liposuction proved to be as safe as the traditional liposuction technique.

This initial study compared power water–assisted and traditional liposuction. We currently are planning a study in which power water–assisted and simple power-assisted liposuction are compared. In fact, the benefits of simple power-assisted liposuction over traditional liposuction have already been addressed, and the next step is to investigate power water–assisted versus power–assisted liposuction in a randomized trial.

Conclusions

Postoperative pain is an important factor that needs to be analyzed when new techniques in cosmetic surgery are introduced. This study gives clear proof that power water–assisted liposuction is an almost painless procedure as compared with tumescent liposuction. Further prospective studies should now be planned with the aim of comparing this new device with other types of liposuction already available.

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