



Body Contouring

A New Suturing Method for Optimal Wound Healing: Technique and Experience

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Abstract

Background: Wound closure utilizing barbed sutures has been associated with healing problems, such as thread extrusion, infection, and the increase of an inflammatory response around the scar.

Objectives: In our study, the senior author described a novel technique of skin incision and wound closure based on de-epithelization and bi-layer tension-free closure that minimizes complications.

Methods: In this retrospective study, the authors reviewed the evolution of wound healing for the novel technique developed by the senior author by analyzing clinical reports of 817 patients who underwent surgery for abdominoplasty or breast reduction utilizing power-assisted liposuction mammoplasty with the new incision and closure technique. In addition, three separate plastic surgeons reviewed the wound characteristics and overall appearance by analyzing photographs that were taken over the course of 12 months to document the healing process.

Results: The overall complication rate was 14.1%, with 0.4% hematoma, 1.25% infection, 0.8% seroma, 1.5% necrosis, 3.75% erythema, 3.3% delayed wound healing, and 3.1% suture extrusion. The authors reported the rate of step-off border (9%), contour irregularities (6.5%), margin separation (1.25%), edge inversion (3.2%), excessive distortion (0.9%), and bad overall appearance (6.4%) of the cases.

Conclusions: This new technique in wound incision and closure based on de-epithelization and bilayer tension-free closure reduces the complications associated with barbed sutures.

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The last decade has witnessed increasing trends toward utilizing barbed sutures for wound closure in plastic and reconstructive surgeries, namely in body contouring procedures.¹⁻⁴ Barbed sutures have many advantages, such as lowering the rate of wound healing problems, securing better wound closure, and reducing the operative time.⁵ Barbed sutures provide a knotless suture technique that prevents complications from buried knots, such as painful granulomas, knot visibility, and palpability.^{4,6-9} Also, barbed sutures have been shown to be more valuable than standard nonbarbed sutures.¹⁰ However, many concerns related to wound healing exist with the use of barbed sutures. Complications such as

thread extrusion, infection, and the increase of an inflammatory response around the scar are commonly described.^{5,6,11-13}

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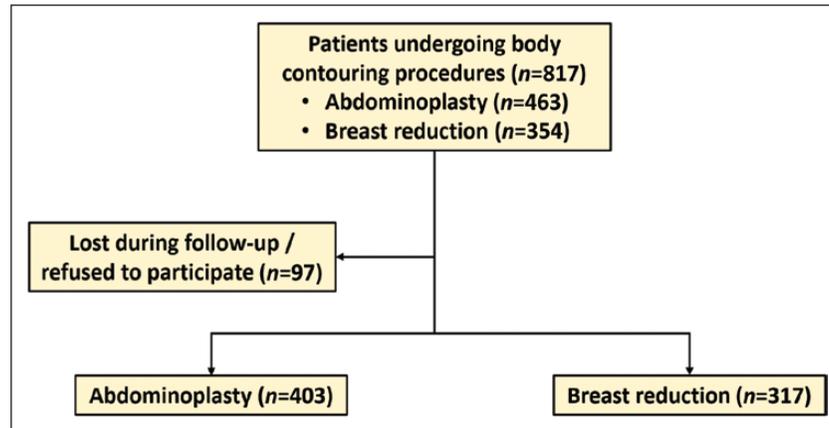


Figure 1. Distribution of the patients.

In our article, we describe a new technique of skin incision and wound closure based on de-epithelization and bilayer tension-free closure that reduces the complications associated with barbed sutures and in turn improves wound healing.

METHODS

Patients and Study Design

In this retrospective study, we reviewed the operative reports and clinical notes of 817 patients who underwent abdominoplasties ($n = 463$) or breast reduction procedures ($n = 354$) using the power-assisted liposuction mammoplasty (P.A.L.M.¹⁴), from January 2012 to December 2018. Of those patients, 97 were lost during follow-up (32 in the breast reduction group and 46 in the abdominoplasty group) or refused to participate in the study (15 in the breast reduction group and 4 in the abdominoplasty group). Thus, 720 patients (403 in the abdominoplasty group and 317 in the breast reduction group) completed the full study (Figure 1). All cases were performed by the same senior surgeon (M.H.A.).

This study was conducted according to the Declaration of Helsinki guidelines. All of the patients were informed of the surgical procedure and provided a written informed consent to participate. We did not receive approval from an Institutional Review Board or ethics committee, given the fact that all patients were treated in a private practice.

Patient characteristics, including age, smoking status, body mass index, massive weight loss, and comorbidities (such as hypertension, hypothyroidism, asthma, sleep apnea, cardiovascular diseases, and thromboembolic events), were studied (Table 1).

Complications, such as delayed wound healing (categorized in the surgeon reports or clinical follow-up notes indicating a suboptimal healing rate), infection, seroma, hematoma, full wound dehiscence, suture extrusion, and thromboembolic events, were studied in all cases (Table 2).

Other wound characteristics in the abdominoplasty group, such as the step-off borders, contour irregularities, margin separations, edge inversions, excessive distortion, and overall appearance, were analyzed by three plastic surgeons who viewed the postoperative photographs that were taken at day 0, 2 weeks, and 1, 3, 6, 9, and 12 months (Table 3). Patients with a tendency for hypertrophic scars or keloids were excluded from this study. The mean dermal closure time utilizing this new method was also assessed.

Surgical Technique

An oblique skin incision is made with the scalpel beveled at a 45° angle. De-epithelialization is performed over a distance of 1 cm (Figures 2 and 3). Then a vertical incision through the de-epithelialized dermis is performed, preserving the 1 cm rim of de-epithelialized dermis. An eversion of the epidermis and an inversion of the dermis are thus achieved.

Wound closure is performed by a single surgeon, the senior author, in a bilayer pattern utilizing a number 0 V-Loc-180 suture (Covidien, Mansfield, MA). The first layer of closure consists of suturing the superficial fascia in a continuous fashion in patients operated on for abdominoplasty. In patients operated on for breast mastopexy, the continuous suture is performed between the dermis and the costal perichondrium. Finally, the wound closure is achieved by utilizing a running barbed suture through the de-epithelialized dermis, permitting the apposition of the epidermis with minimal tension (Figure 4). Videos 1 and 2 illustrating this technique are available online as Supplementary Material at www.asjopenforum.com.

Postoperative Care

After the operation, all patients had their wounds treated with Flaminal Hydro (Flen Health Pharma, Belgium) daily for 2 weeks until a scar formed. This wound-healing agent was then replaced with Cicaplast (La Roche-Posay, France)

Table 1. Patient Demographics

Characteristics	Abdominoplasty	Breast reduction
Mean age, years (range)	30 (22–42)	31 (20–42)
Gender (male/female)	80 / 323	0/317
Mean follow-up, months (range)	21 (11–32)	31 (17–48)
Mean BMI, kg/m ² (range)	30.3 (23–37)	30.8 (25–37)
Hypertension (%)	108 (27)	60 (19)
Diabetes (%)	48 (12)	26 (8)
Hypothyroidism (%)	32 (8)	23 (7)
Asthma (%)	44 (11)	44 (14)
Sleep apnea (%)	8 (2)	0
Cardiovascular disease ^a (%)	12 (3)	6 (2)
Thromboembolism (%)	5 (1)	10 (3)
Smokers (%)	56 (14)	57 (18)
Massive weight loss (%)	70 (17)	99 (31)

BMI, body mass index. ^aCardiovascular disease include dyslipidemia and any other cardiac or vascular pathology other than hypertension and thromboembolism.

Table 2. Complications

Complications	Abdominoplasty <i>n</i> = 403	Breast reduction <i>n</i> = 317	Overall <i>n</i> = 720
Full wound dehiscence	0	0	0
Hematoma (%)	0	3 (0.9)	3 (0.4)
Infection (%)	6 (1.5)	3 (0.9)	9 (1.25)
Seroma (%)	4 (1)	2 (0.6)	6 (0.8)
Necrosis (%)	5 (1.2)	6 (1.9)	11 (1.5)
Erythema (%)	16 (3.9)	11 (3.5)	27 (3.75)
Delayed wound healing (%)	11 (2.7)	13 (4.1)	24 (3.3)
Suture extrusion (%)	9 (2.2)	13 (4.1)	22 (3.1)
Thrombo-embolism	0	0	0
Overall complications (%)	51 (12.7)	51 (16.1)	103 (14.3)

Table 3. Wound Characteristics in the Abdominoplasty Group

Characteristics	Surgeon 1 <i>n</i> = 403	Surgeon 2 <i>n</i> = 403	Surgeon 3 <i>n</i> = 403	Average
Step-off border (%)	33 (8.2)	35 (8.7)	52 (12.9)	40 (9.9)
Contour irregularities (%)	29 (7.2)	25 (6.2)	27 (6.7)	27 (6.69)
Margin separation (%)	5 (1.2)	6 (1.5)	4 (0.99)	5 (1.24)
Edge inversion (%)	13 (3.2)	17 (4.2)	9 (2.2)	13 (3.23)
Excessive distortion (%)	0	0	0	0
Bad overall appearance (%)	14 (3.5)	47 (11.7)	26 (6.5)	29 (7.19)

once a day for 3 months. We recommend to all patients to perform a daily massage of the scar, starting 1 week postoperatively.

RESULTS

In this retrospective study, we reviewed the operative reports and clinical notes of 817 patients who underwent abdominoplasties (*n* = 463) or breast reduction procedures (*n* = 354) from January 2012 to December 2018. Among those patients, 97 patients did not complete the study; 78 patients were lost during follow-up (32 in the breast reduction group and 46 in the abdominoplasty group); and 19 refused to participate to the study (15 in the breast reduction

group and 4 in the abdominoplasty group). All cases were performed by the same senior surgeon.

A total of 720 patients were enrolled in this study, of which 403 underwent abdominoplasty and 317 underwent breast reduction surgery. Among these patients, 27% in the abdominoplasty group suffered of hypertension vs 19% in the breast reduction group. Also, diabetes, sleep apnea, and cardiovascular diseases were more prevalent in the abdominoplasty group (12%, 2%, and 3%, respectively) vs the breast reduction group (8%, 0%, and 0.2%, respectively).

Smokers and patients with a history of asthma, thromboembolism, or massive weight loss were more prevalent in the breast reduction group (18%, 14%, 3%, and 31%

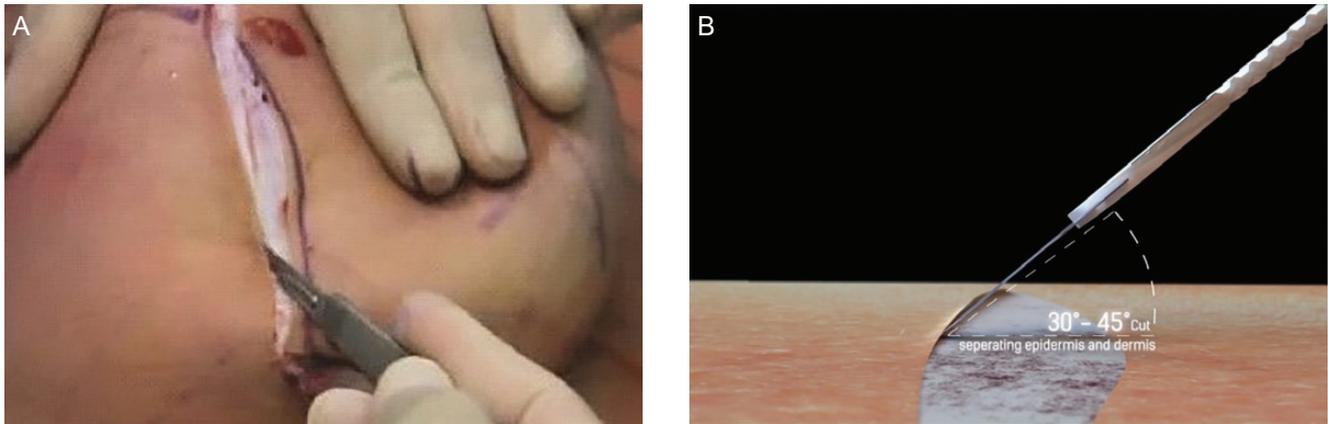


Figure 2. (A) Following skin incision, de-epithelialization is performed with a 45° angle over a distance of 1 cm, (B) leaving an eversion of the epidermis and an inversion of the dermis. This is the case of a 36-year-old female patient who underwent a breast reduction using the P.A.L.M. technique.



Figure 3. The distance of de-epithelialization.

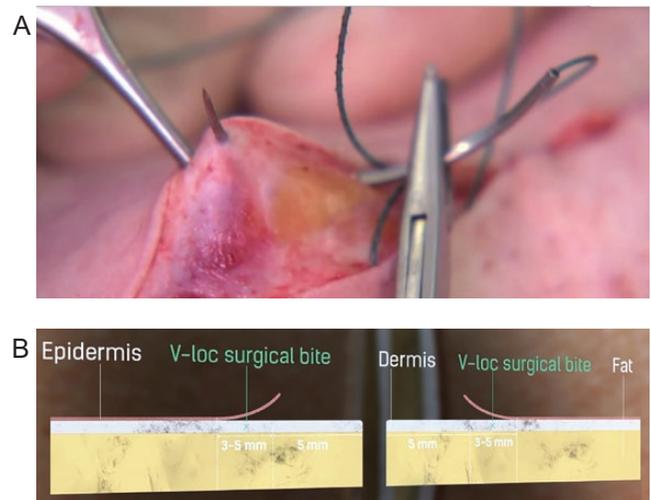


Figure 4. (A) The running barbed suture passes through the de-epithelialized dermis 8 to 10 mm from the incision. This is the case of a 47-year-old female patient who underwent an abdominoplasty. (B) The location of the dermal bite. The bite is taken in the dermis 8 to 10 mm distal to the incision.

respectively) vs the abdominoplasty group (14%, 11%, 1%, and 17%, respectively) (Table 1).

The overall complication rate was 14.3% (12.7% in the abdominoplasty group and 16.1% in the breast reduction group). We reported some cases of infection (1.5% and 0.9% of the patients in the abdominoplasty and breast reduction groups, respectively) and seroma (1% and 0.6% of the patients in the abdominoplasty and breast reduction groups, respectively). Full wound dehiscence and thromboembolisms were not reported in the abdominoplasty group or the breast reduction group. Three patients (0.9%) suffered from hematomas in the breast reduction group, although there were no reported cases of hematoma in the abdominoplasty group. Necrosis was reported by five patients

in the abdominoplasty group (1.2%) and six patients in the breast reduction group (1.9%). Erythema was observed in 3.9% of the patients who underwent abdominoplasty and in 3.5% of the patients who underwent breast reduction. A delay in wound healing and suture extrusion occurred in 2.7% and 2.2%, respectively, of patients the abdominoplasty group, and in 4.1% and 4.1% of patients in the breast reduction group (Table 2).

Wound characteristics were evaluated for both groups by three independent surgeons (Tables 3 and 4). An overall rate of step-off border, contour irregularities, margin separation, edge inversion, excessive distortion, and bad overall appearance were reported by 9%, 6.5%, 1.25%, 3.2%, 0.9% and 6.4% of the cases, respectively (Table 5).



Video 1. Watch now at <http://academic.oup.com/asjof/article-lookup/doi/10.1093/asjof/ojaa008>.



Video 2. Watch now at <http://academic.oup.com/asjof/article-lookup/doi/10.1093/asjof/ojaa008>.

Table 4. Wound Characteristics in the Breast Reduction Group

Characteristics	Surgeon 1 n = 317	Surgeon 2 n = 317	Surgeon 3 n = 317	Average
Step-off border (%)	22 (6.9)	24 (7.6)	29 (9.1)	25 (7.89)
Contour irregularities (%)	11 (3.5)	27 (8.5)	22 (6.9)	20 (6.31)
Margin separation (%)	5 (1.6)	1 (0.3)	0	4 (1.26)
Edge inversion (%)	9 (2.8)	9 (2.8)	11 (3.5)	10 (3.15)
Excessive distortion (%)	7 (2.2)	5 (1.6)	9 (2.8)	7 (2.21)
Bad overall appearance (%)	20 (6.3)	21 (6.6)	10 (3.2)	17 (5.36)

Table 5. Overall Wound Characteristics

Characteristics	Abdominoplasty n = 403	Breast reduction n = 317	Overall n = 720
Step-off border (%)	40 (9.9)	25 (7.89)	65 (9)
Contour irregularities (%)	27 (6.69)	20 (6.31)	47 (6.5)
Margin separation (%)	5 (1.24)	4 (1.26)	9 (1.25)
Edge inversion (%)	13 (3.23)	10 (3.15)	23 (3.2)
Excessive distortion (%)	0	7 (2.21)	7 (0.9)
Bad overall appearance (%)	29 (7.19)	17 (5.36)	46 (6.4)

Table 6. Wound Closure Time

Procedure	Deep dermal suture	Intradermal suture	Total
Abdominoplasty closure, min (n = 403)	2.5	4	6.5
Breast reduction closure, min (n = 317)	2.1	6.2	8.3

Photographic assessments over 1 year showed the optimal evolution of the scar in both abdominoplasties (Figure 5) and breast reduction surgeries. The pictures were taken at day 0 and then postoperatively after 2 weeks and 1, 3, 6, 9, and 12 months.

The wound closures were all performed by a single surgeon, the senior author. The mean time of closure was assessed at 6.5 minutes in the abdominoplasty group, and 8.3 minutes in the breast reduction group (Table 6).

DISCUSSION

Wound closure is a key step in body contouring procedures. Various incision closures have been developed to improve wound healing and to reduce complications. Barbed sutures are among the new designs to secure wound closure and achieve better aesthetic results.¹⁵⁻¹⁸ They were originally utilized for minimally invasive face and neck rejuvenation, and they rapidly gained popularity in different aspects of plastic surgeries.^{1-4,7-9} Barbed sutures have the advantage of providing a rapid, secure, knotless suture technique for large wound closure, with more even distribution of tension across the wound. However, many complications have been

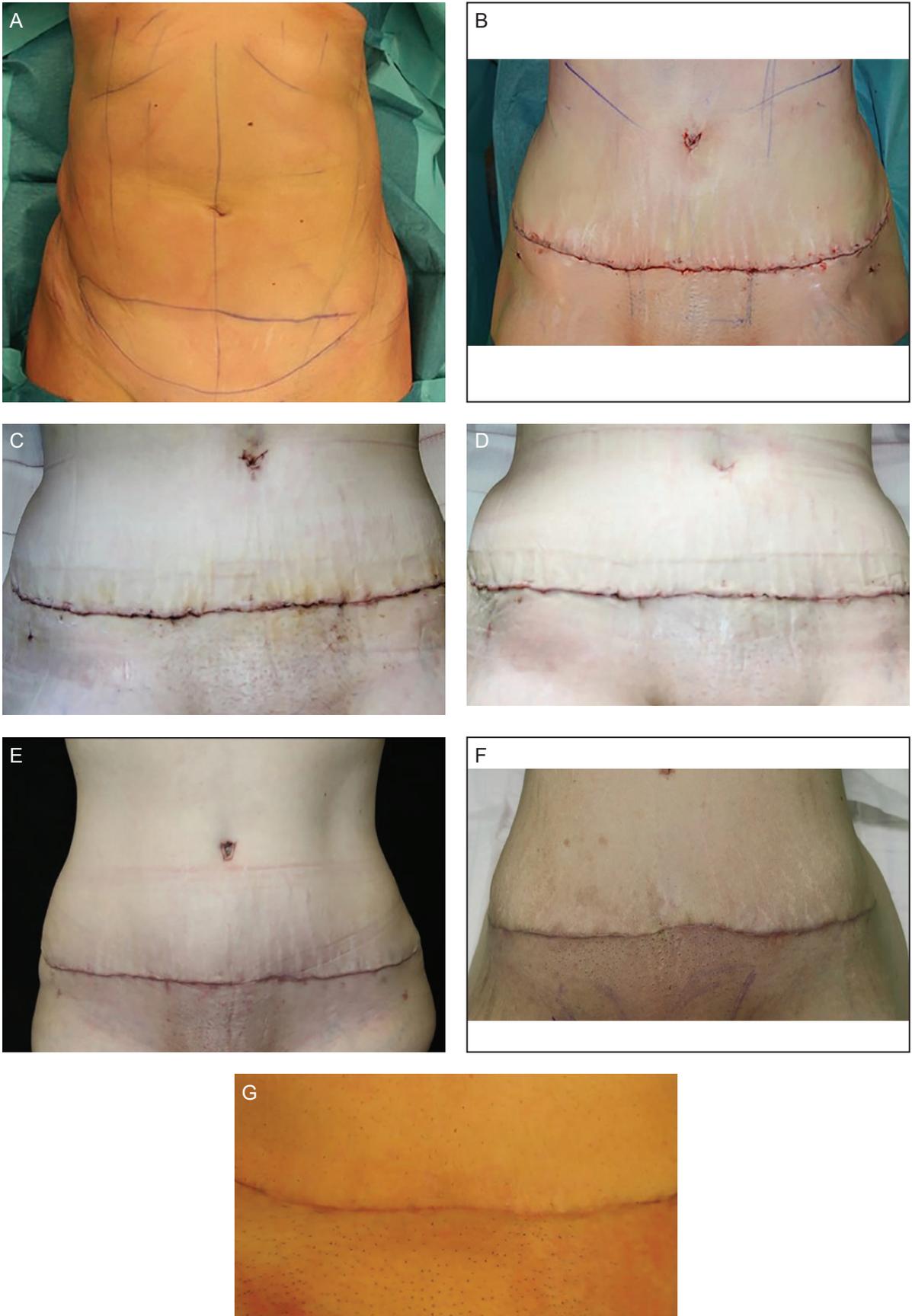


Figure 5. (A) The preoperative markings and evolution of the scar are shown using this new technique on a 36-year-old female from day 0 to postoperatively at (B) 2 weeks, (C) 1 month, (D) 3 months, (E) 6 months, (F) 9 months, and (G) 12 months.

Table 7. Review of Studies Evaluating the Side Effects of Barbed Sutures

Study	No. of procedures using barbed sutures	Complications	Duration of follow-up
Rubin et al ⁵	229 • 115 with slow-absorbing polymer (S) • 114 with rapid-absorbing polymer (R)	Overall complications 26.1% (S) and 16.7% (R) • Wound dehiscence in 1.7% (S) and 3.5% (R) • Hematoma in 2.6% (S) and 3.5% (R) • Seroma in 0% (S) and 1.8% (R) • Infection in 3.5% (S) and 1.8% (R) • Erythema in 0.9% (S and R) • Suture extrusion in 20% (S) and 8.8% (R)	12 weeks
Cortez et al ¹⁹	298	Overall complications 25.2% • Wound dehiscence in 8.7% • Erythema in 7% • Infection in 6.7% • Seroma in 3.4% • Necrosis in 2.7% • Hematoma in 2.3%	>60 days
Shermak et al ¹²	114	Overall complications 20.2% • Wound-healing problems in 14.9% • Hematoma in 2.6% • Seroma in 0.9% • Infection in 0.9% • Thromboembolism in 0.9%	
Hurwitz et al ¹³	546	Overall complications 39.2%	Up to 36 months
Lycka et al ²⁰	350	• Ecchymosis in 47% • Bleeding in 46% • Swelling in 43% • Erythema in 14% • Discomfort in 14% • Asymmetry in 3% • Thread extrusion in 3%	

reported with barbed sutures, such as thread extrusion, infection, palpability, and an increased inflammatory reaction across the wound edges.^{6,7,10,12} Shermak et al¹² evaluated barbed sutures for wound closure in body contouring surgery and found that they are associated with wound healing problems, especially in the arms. They attributed these problems to the large surface of barbs across the wound, the long absorption period of the threads causing a latent inflammatory response, and subclinical seromas that promoted infection.¹² They reported an overall complication rate of 20.2%, and hematomas, seromas, and infection were respectively reported in 2.6%, 0.9%, and 0.9% of cases. In their study, 14.9% of patients suffered from wound healing problems (Table 7).¹²

Rubin et al⁵ compared absorbable barbed sutures with conventional absorbable sutures for dermal closure of wounds in open surgeries. They concluded that the rapid-absorbing barbed sutures (the V-Loc 90 with a 90-day absorption profile) and the smooth sutures have a similar complication profile, whereas the slow-absorbing suture (V-Loc 180 with a 180-day absorption profile) has more minor suture extrusion.⁵ They reported an overall complication rate of 26.1% with slow-absorbing barbed sutures, with 1.7% wound dehiscence, 2.6% hematoma, 3.5% infection, 0.9% erythema, 20% suture extrusion, and no cases

of seroma.⁵ Cortez et al,¹⁹ Hurwitz et al,¹³ and Lycka et al,²⁰ also reported complications utilizing barbed sutures, the details of which are summarized in Table 7.

In our study, we utilized the V-Loc 180 for wound closure and observed lower complication rates than previous studies evaluating the side effects of barbed sutures. Although we reported an overall complication rate of 14.3%, with 0.4% hematoma, 1.25% infection, 0.8% seroma, 1.5% necrosis, 3.75% erythema, 3.3% delayed wound healing, 3.1% suture extrusion, and no cases of thromboembolism or full wound dehiscence (Table 2), we believe that our low complication profile was associated with the use of a large-caliber, slow-absorbing barbed suture. First, the de-epithelialization provides eversion of the epidermis and inversion of the dermis. During wound closure, surgical bites will only pass through the dermis, alleviating tension on the epidermis and preventing fat necrosis. As a result, the epidermis will act as a biologic dressing to protect the underlying thread of V-Loc. Moreover, we consider that the vascularization of the epidermal flap is preserved even though the de-epithelialization is performed up to 1 cm from the incision. Second, the large caliber of suture that we utilize allows us to make fewer entries in the dermis, reducing the potential for bacterial contamination and wound infection.

The assessment of the aesthetic or healing outcomes of the scars was unfortunately not standardized in our work, limiting thus the comparison to other studies.

In our study, the mean time of closure for an abdominoplasty operation utilizing this new method was 6.5 minutes. Compared with previous studies in the literature, the technique described by the senior author reduces operative time. Indeed, Rubin et al⁵ and Koide et al²¹ reported an overall closure time of 12 minutes utilizing barbed sutures, whereas Grigoryants and Baroni¹¹ assessed an average of 7.9 minutes. In another study, Warner and Gutowski¹ assessed a mean closure time of 9 minutes. Shorter surgical durations are associated with a reduced anesthesia time that may benefit the patient in decreasing the postoperative complications.

The quality of the scar not only relies on the suturing technique but also on postoperative care. In our practice, we utilized Flaminal Hydro for 1 week. The advantage of utilizing Flaminal Hydro has been proven in the literature. Indeed, it enhances wound healing through its antimicrobial activity and through maintenance of a moist wound-healing environment.^{22,23}

Massage therapy is also recommended to all of our patients 1 week postoperatively, even though there is no concrete evidence of its effectiveness.²⁴

All of these factors could explain the favorable appearance of the wound in our patients. Indeed, we reported a bad overall appearance in only 6.4% of our patients (Tables 3-5).

CONCLUSIONS

Barbed sutures are increasingly utilized for wound closure in body contouring surgery. In order to reduce complications associated with this type of suture, the senior author introduced a new technique in wound incision and closure based on de-epithelization, large-caliber sutures, and bi-layer tension-free closure.

Disclosures

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