

Progressive Tension Sutures in Abdominoplasty: A Review of 597 Consecutive Cases

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Aesthetic Surgery Journal
32(6) 729–742
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DOI: 10.1177/1090820X12452294
www.aestheticsurgeryjournal.com


Abstract

Background: Although abdominoplasty and other body-contouring procedures are being performed more frequently, the incidence of seroma and other complications has remained relatively unchanged. In 2000, a small retrospective series introduced progressive tension sutures (PTS) in abdominoplasty to reduce seroma without the use of drains.

Objectives: The authors review the PTS technique and their experience with the procedure.

Methods: A retrospective chart review of 597 consecutive abdominoplasty patients treated over 12 years was performed. Collected data included surgical setting, concomitant procedures, and complications.

Results: Of the 597 abdominoplasties, 52.4% were performed in the hospital and 47.6% in an American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF)-accredited facility. In 63.7% of cases, abdominoplasty was combined with another procedure(s). Liposuction was performed on the abdominoplasty flap or an adjacent area to the abdominoplasty dissection in 67% of patients. The average amount fat aspirate from these areas was 953 mL. No drains were placed. The rate of local complications was 4.2%; all but one of these complications (seroma; 0.1%) were minor. There were no systemic complications related to PTS and no venous thromboembolisms.

Conclusions: PTS are an adjunct to abdominoplasty that can minimize seroma and potentially decrease other local complications. They provide secure fixation of the flap to eliminate motion and broadly transfer tension to the superficial fascial system. Drains can safely be eliminated from abdominoplasty, even when liposuction is performed. Systemic complications may be avoided and patient recovery expedited.

Keywords

progressive tension sutures, quilting sutures, seroma, abdominoplasty, body contouring

Accepted for publication January 30, 2012.

Abdominoplasty is reportedly the fourth most common cosmetic procedure in the United States; 114,929 abdominoplasties were performed in 2010 alone, which represents an increase of 300% since 1997.¹ This number likely will continue to grow as bariatric procedures increase in popularity. The most commonly reported complication of abdominoplasty is seroma, which results in patient concerns, greater follow-up time for the surgeon and staff, and occasionally a difficult-to-manage chronic condition. In their report on a large series of abdominoplasties, Chaouat et al² emphasized the “high risk of early complications,” noting a seroma incidence of 10.9%. In other studies, the frequency of seroma has been highly variable.^{3,4}

In the plastic surgery literature, many theories have been proposed concerning the etiology of seroma as a complication of abdominoplasty; these include concomitant liposuction,⁵⁻⁷ dead space due to extensive dissection, disruption of abdominal lymphatics,⁸⁻¹⁰ and postoperative movement by the patient.¹¹⁻¹³ Although the etiology of seroma formation in abdominoplasty has not been determined, the low

incidence of seroma when the flap is affixed securely to the deep fascia with progressive tension sutures (PTS) suggests that flap motion may play a significant role.

Other complications such as venous thromboembolism (VTE), although much less common, also are of great concern to patients who undergo abdominoplasty. With abdominoplasty alone, the incidence of VTE ranges from 1.4% to 2.0%.¹⁴ When abdominoplasty is combined with other procedures, the incidence of VTE is approximately 6.6%.¹⁴ These rates are extremely high in comparison to other procedures of similar duration, such as face-lift, for

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which the VTE incidence is 0.35%.¹⁴ Current trends point towards broadening of the indications for anticoagulant chemoprophylaxis that will likely result in a higher incidence of hematoma.^{14,15}

We initially employed the PTS technique in a small series ($n = 76$) of abdominoplasties reported in 2000.¹² Other investigators, including Baroudi and Ferreira,¹³ Georgiade,¹⁶ and LeLouran and Pascal,¹⁷ have used similar suture fixation techniques in abdominoplasty. PTS are an adjunctive step that can be applied to most abdominoplasty procedures. These sutures provide active advancement and secure fixation of the flap, which reduces dead space, allows for early mobilization of the patient in an upright position, and eliminates the need for postoperative drains.

The present study, a large consecutive series of abdominoplasties performed with PTS, provides additional evidence of the decrease in local complications including seroma, which was achieved without the use of postoperative drains. It also indicates that the risk of VTE may be lower, and a mechanism for this is suggested.

METHODS

Similar to our previous study,¹² a retrospective chart review was conducted of all abdominoplasties ($n = 597$) performed by the authors during a 12-year period (January 1998 through December 2009) following the original series. The compiled data included patient demographics, surgical setting, type of anesthesia, concomitant procedures, complications, and duration of follow-up. The primary objective of this study was to evaluate the incidence of early complications with use of the PTS technique when applied to abdominoplasty. Therefore, aesthetic outcomes, other than those related to early complications, were not addressed.

Surgical Technique

The surgical technique of abdominoplasty with PTS has been described in detail elsewhere.¹⁸ The sutures are simply an adjunct that can be incorporated into any abdominoplasty procedure.

The patient was marked in the recumbent and standing positions, noting the midline, planned incisions, and areas to be liposuctioned. All patients had sequential compression devices placed prior to induction, and other VTE-prevention modalities were individualized. Posterior liposuction was performed with the patient in the prone position. For the abdominoplasty, the patient was placed supine, and arms were secured on arm boards. A pillow was placed under the knees. A wide skin prep and draping was used to the mid thighs.

The procedure began with infiltration of the local anesthetic into the planned incision sites, and areas of planned elevation and liposuction were infiltrated with standard tumescent solution (1000 mL normal saline, 30 mL lidocaine, and 1 mL epinephrine 1:1000). If the upper abdomen was

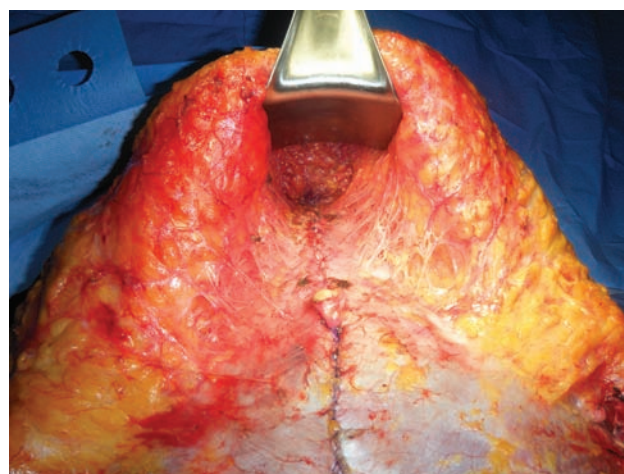


Figure 1. Typical degree of flap elevation. Rectus diastasis has been repaired, and lateral areas show preserved septi from liposuction performed in the deep plane of the flap.

particularly bulky, liposuction was performed in the upper abdomen and flanks prior to flap elevation. Care was taken to suction deeply to Scarpa's fascia to avoid flap devascularization and to prevent oversuctioning and mismatch between the thinner upper abdominal skin and the thicker mons area.

Circumumbilical and low transverse suprapubic incisions were made and carried down to the muscle fascia. The flap was elevated at the level of the deep fascia, and no attempt was made to leave fat on the fascia, except where it was determined to be aesthetically favorable. Dissection was carried out both sharply and with electrocautery. The technique and extent of dissection was based on the surgeon's judgment and on individual aesthetic needs. In most cases, we used a triangular dissection that was wider inferiorly and narrowest at the level of the xyphoid (Figure 1). When dissection was complete, rectus diastasis (if present) was repaired with a 0-0 braided nylon suture, either as a figure-of-eight or with simple inverted sutures spaced approximately 1 cm apart, followed by a second layer of 0-0 PTS barbed suture in an over-and-over fashion.

If a ptotic mons pubis was present, correcting it was important for achieving a good aesthetic result. The mons was undermined as needed, and several 2-0 Vicryl (Ethicon, Inc; Somerville, New Jersey) sutures were placed from the underside of the mons to the desired position on the deep fascia. In general, only 3 sutures were needed: 1 midline, and 1 on either side, with spacing of 3 to 4 cm. Advancement to an appropriate position, with secure fixation by PTS, maintained the mons in an attractive position and prevented excessive elevation by flap retraction.

The patient was then brought to a flexed position of approximately 45° to 60° at the hips, with the knees bent slightly. The bed was placed in the Trendelenburg position so that the torso was parallel to the floor. This position aided the visualization of PTS placement. A large, broad retractor was placed to visualize the most superior extent

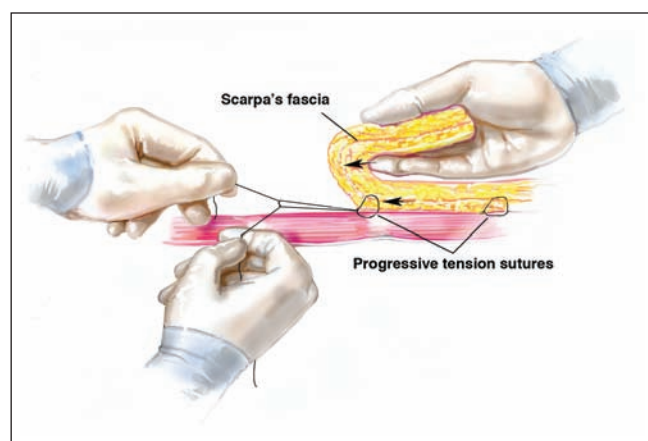


Figure 2. The assistant maintains the flap advancement, which allows the surgeon to easily secure the suture without flap retraction.

of dissection. While the assistant held the retractor in place, the surgeon placed the nondominant hand on the skin behind the flap and advanced it. With the dominant hand, a 0-0 Vicryl suture on a large needle (CTX; Ethicon, Inc.; Somerville, New Jersey) was placed from below into the midline of the flap. Care was taken to ensure that Scarpa's fascia was included in the bite. As the suture was placed, the depth of its placement was felt with the nondominant hand. The assistant's dominant hand then replaced the surgeon's nondominant hand on the skin side of the flap to stabilize the flap advancement and relieve tension while the surgeon tied the suture (Figure 2). This was repeated, at intervals of approximately 2 cm, until the umbilicus was reached. This typically required 2 to 3 sutures in the supraumbilical midline (Figure 3). Once the flap was secured by PTS to the level of the umbilicus, the umbilicus was inset in continuity with the flap advancement. This approach allowed the suture line and final scar to be hidden in the depths of the umbilicus and created an attractive umbilical dimple.

A 2-cm circle of the overlying flap was defatted, and a circular or vertically oriented oval of skin was excised with a No. 15 blade. From the underside of the flap, 3-0 Vicryl was placed in a 3-point suture formation from the abdominal skin dermis to the umbilical stalk dermis to the muscle fascia at 12, 3, 6 and 9 o'clock around the stalk. Tying the sutures created a neoumbilical depression and splinted the umbilical incision from contracture. After complete closure of the abdomen, the umbilical skin edges were approximated with a few interrupted 5-0 Prolene (Ethicon, Inc.; Somerville, New Jersey) sutures (Figures 4 and 5).

Once the umbilicus was inset, flap advancement was continued in a similar fashion. Sutures were placed in a triangular pattern. The sutures in the midline were placed approximately 2 to 3 cm apart and with the greatest amount of advancement. Lateral sutures were placed more sparsely, and care was taken to place them symmetrically, from side to side, in regard to location and degree of advancement. Less advancement was needed laterally because the flap had already been advanced by the midline sutures. Typically, 4 or 5 sutures were placed in the infraumbilical midline, and 3 to 5 sutures were placed peripherally on either side. In general, a total of 10 to 18 PTS were placed, but the number varied depending on the degree of dissection, patient size, and surgeon's judgment.

Once the entire flap had been secured, the excess tissue was determined, marked, and resected. Three-point sutures were placed between the edges of Scarpa's fascia and the muscle fascia using 2-0 Vicryl spaced approximately 3 cm apart. The skin was closed with 3-0 Vicryl deep dermal sutures and a running subcuticular suture. Several simple Prolene sutures were used to approximate the umbilical skin edges.

Although we did not use drains of any kind, some surgeons have placed suction drains in addition to using PTS. However, studies have shown that there is no advantage to using drains with PTS.^{19,20} Moreover, the placement of PTS is more difficult when drains are in the surgical field, which may increase operating time and the surgeon's learning curve.

Postoperatively, some patients stayed overnight at the surgeon's discretion or by patient request. Patients were

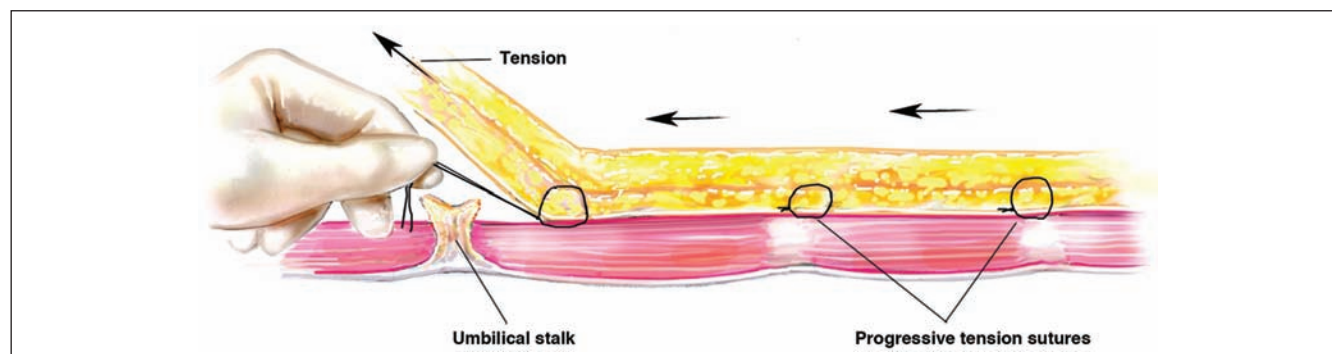


Figure 3. The supraumbilical flap has been advanced to the level of the umbilicus. Typically this is achieved with 2 or 3 PTS. Each subsequent PTS relieves tension from the previous one.

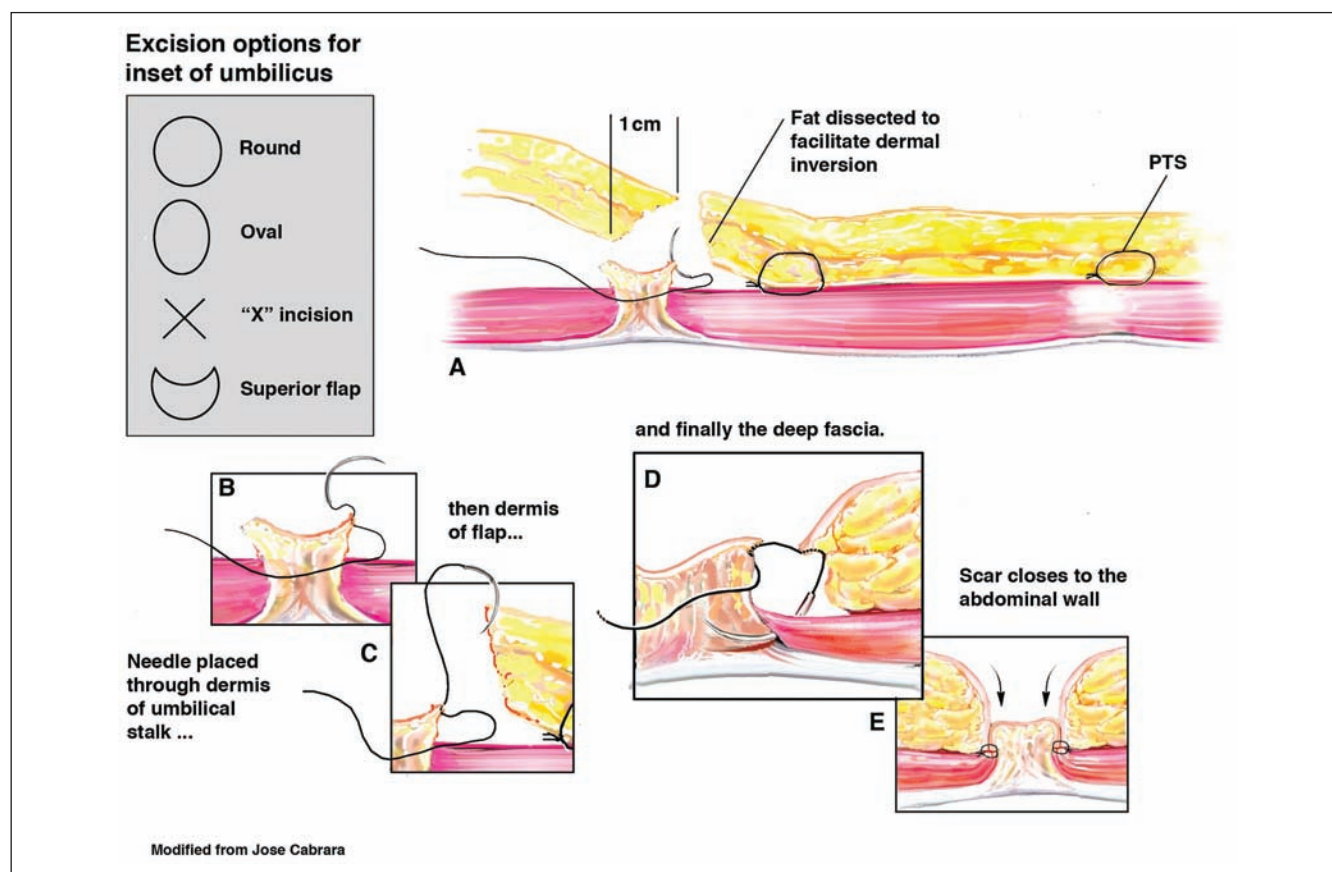


Figure 4. In-continuity umbilical inset. (A) Once the flap has been advanced to the level of the umbilicus, a 1-cm area of subcutaneous fat is removed at the projected site of inset. (B, C, D) One of 4 quadrant 3-point sutures is placed from the deep dermis of the umbilical stalk remnant to the dermis of the flap, and then through the deep fascia. (E) After the suture is tied, the periumbilical incision is approximated and inverted into the umbilical depression. The shape of the incision in the flap is determined by the surgeon.

ambulated as early as possible after surgery and were encouraged to walk as upright as tolerable. While ambulating or recumbent, patients were not required to maintain a hip-flexed position. A compressive binder was used on all patients for comfort and abdominal support. Patients were encouraged to increase activities as tolerated but were advised to avoid strenuous exercise, abdominal exercise, and lifting of greater than 5 pounds for the first 6 weeks postoperatively.

RESULTS

During the study period, 597 abdominoplasties were performed by the authors (332 [55.6%] by TP; 265 [44.4%] by HP). Most patients were women (98.3%), and the average patient age was 46.5 years (range, 21-71 years). Average BMI was 29.1 (range, 18.1-41), and average weight was 172.5 lb (range, 98-280 lb). The average follow-up period was 13.7 months. Records did not always clearly indicate previous weight reduction surgery, but available documentation shows that 10.1% of patients underwent some form of bariatric surgery prior to the

body contouring procedure. Although smokers (13.2% of the study group) were encouraged to discontinue smoking prior to surgery, smoking cessation was not required.

The abdominoplasty was performed in a hospital (52.4%) in an ambulatory surgery center, or in an AAAASF-accredited office operating room (47.6%). General anesthesia was administered in 68.3% of cases, and conscious sedation in 31.7%. The conscious sedation technique was similar to that described by Kryger et al²¹; however, a licensed anesthesia specialist (MD or certified registered nurse anesthetist [CRNA]) was present for all of our procedures in these patients. Fewer than one-third of the patients (28.3%) stayed overnight, and no patient (other than those who had a concurrent gynecologic procedure) stayed longer than one night.

There were 456 (76.4%) full abdominoplasties and 141 (23.6%) modified abdominoplasties. Throughout the study, a trend toward fewer modified (or more limited) abdominoplasties was observed (Figure 6). The decision to perform liposuction on the abdomen and/or adjacent areas, such as flanks, was determined by the patient's aesthetic needs and/or the surgeon's judgment; 67% of patients underwent this adjunct procedure. We routinely performed

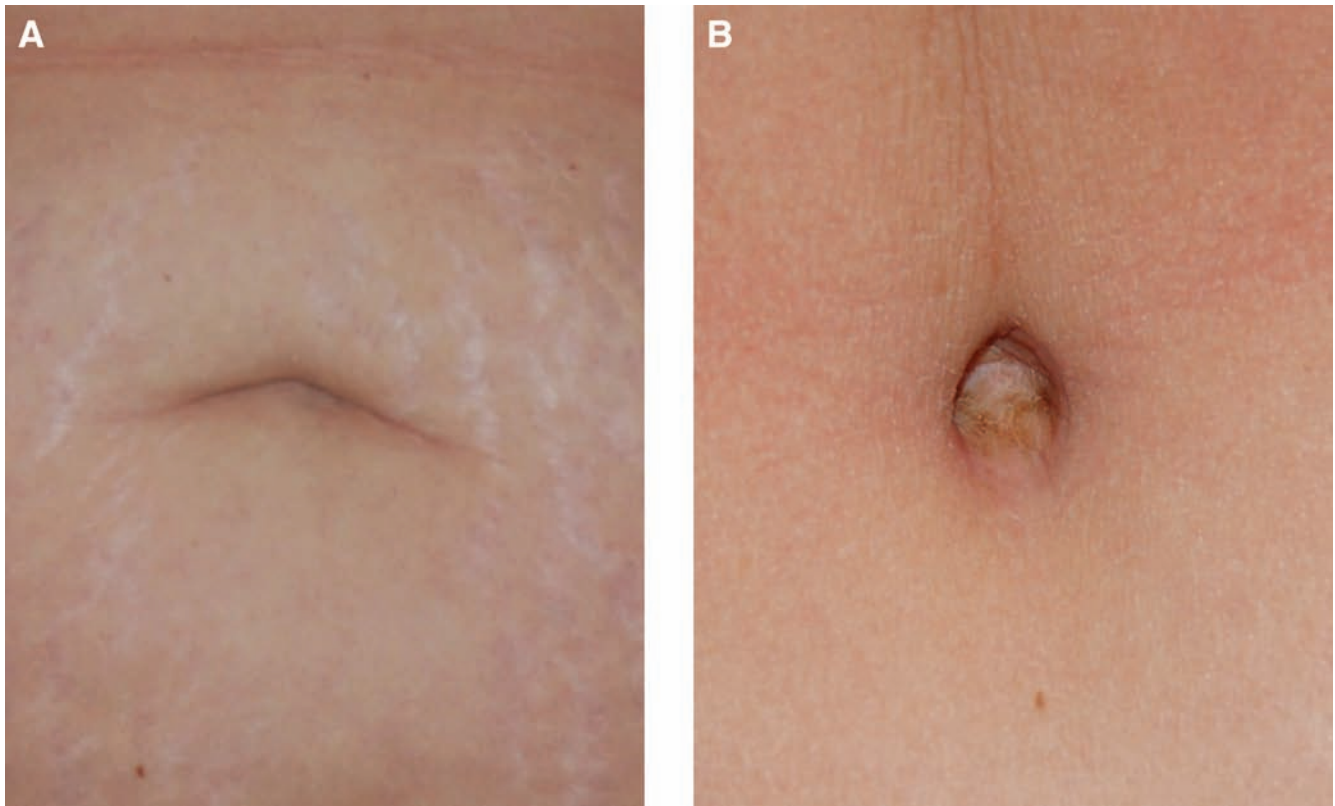


Figure 5. (A) Before and (B) after umbilical inseting. The postoperative image shows the depth of the umbilicus and the natural appearance that can be achieved.

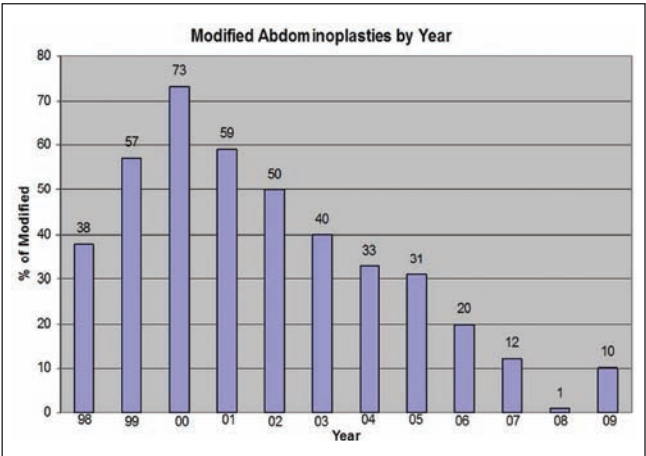


Figure 6. Throughout the study period, there was an overall decline in the number of modified (limited) abdominoplasties performed. This was attributable to the more aggressive flap advancement achieved when PTS is used, which has resulted in more patients being eligible for full abdominoplasty.

power-assisted liposuction with a 5-mm cannula. Care was taken to stay in the deep plane of the abdominal flap. An average of 953 mL of fat was suctioned.

At least one additional procedure (other than abdominal or flank liposuction) was performed in conjunction

Table 1. Procedures Performed in Conjunction With Abdominoplasty

Breast		n
	Augmentation	64
	Mastopexy	71
	Reduction	13
	Other breast	21
Other body contouring		
	Liposuction (other than abdomen or flanks)	142
	Thigh-lift	5
	Brachioplasty	3
Facial cosmetic		50
Hernia		49
Scar revision		2
Gynecologic		36

with abdominoplasty in 63.7% of patients, 24% of whom had more than one additional procedure (Table 1). Breast

Table 2. Complications

Complication		n
Local complications (%)		4.20
Necrosis		
	Major	1
	Minor	4
Infectious		
	Cellulitis	7
	Abscess	2
Nerve entrapment		3
Fat necrosis		2
Hematoma		2
Seroma		1
Dehiscence		
	Major	0
	Minor	3
Systemic complications (%)		0.05
Venous thromboembolism		0
Anxiety attack		1
Psychotic episode		1

surgery was performed in 169 patients (28.3%). Breast procedures included augmentation, reduction, mastopexy, and secondary procedures. A total of 142 patients (23.8%) had liposuction in one or more areas outside the abdomen or flanks. Facial procedures were performed in 8.4% of patients, and herniorrhaphy in 8.2%. All hernias were either ventral or umbilical, and all were closed primarily. Gynecologic procedures were performed in 36 patients (6%).

Overall, there were 25 local complications (4.2%). There were 6 (0.88%) infectious complications: 3 cases of cellulitis and 3 abscesses (Table 2). All abscesses were small and localized. One was clearly related to a local anesthetic pain-pump device; the abscess was in the upper abdomen and drained spontaneously from an insertion site. There was 1 seroma (0.1%), which required 3 aspirations to resolve. It was in the suprapubic region. There were 5 cases of skin-flap necrosis, 1 major and 4 minor ($< 1 \text{ cm}^2$). All patients who experienced necrosis had preexisting surgical scars. The cases of minor necrosis involved the T-junction of a vertical incision, which was allowed to heal secondarily. The case of major necrosis was not as easily explained by a preexisting scar alone. The patient did have a right subcostal scar from an open cholecystectomy incision, and there was necrosis in a triangle where the cholecystectomy scar

met the abdominoplasty incision. However, there was a second area of necrosis that excluded viable tissue but included a large periumbilical area. We have not been able to definitively identify an etiology that would satisfactorily explain this complication. Both wounds were closed in a delayed primary fashion.

There were 3 cases of nerve entrapment involving the lateral femoral cutaneous nerve at the level of the incision. These were associated with the 3-point suture that was placed to approximate the superficial fascia at the level of the incision. In these cases, conservative measures failed to relieve the characteristic nerve pain radiating to the area of sensory nerve distribution, and therefore the entrapment was re-explored under local anesthesia. Instant relief of the pain was achieved when a suture was released from the superficial fascia.

There were 2 localized hematomas: 1 in the upper abdomen (which was aspirated) and 1 at the incision level (which was opened and drained). The PTS were very effective in compartmentalizing the hematomas, appearing to limit their severity. Neither of these complications appeared directly related to the PTS; rather, the sutures seemed helpful for containing the collections. There were no cases of deep venous thrombosis or pulmonary embolism.

There were no physical systemic complications, but there were 2 psychological events. Shortness of breath occurred in a patient on the evening of postoperative day 1. She was evaluated in the emergency room, and findings were negative for VTE, pulmonary, or cardiac etiology. The symptoms resolved spontaneously and were determined to be caused by an anxiety attack. Another patient experienced a psychotic episode while in the hospital on the night of surgery. She had no history of psychosis, and a short period of inpatient psychiatric treatment was required.

A total of 64 patients (10.7%) underwent one or more revision procedures (86 revisions overall), none of which appeared related to the PTS. There were 48 minor dog-ear revisions, 25 touch-up liposuction procedures, and 20 scar revisions. Although the number of revisions was relatively high, this most likely relates to our liberal revision policy that minimizes additional cost to the patient. Our philosophy on revisional surgery is described in the 2007 editorial titled "Is Reoperation Rate a Valid Statistic in Cosmetic Surgery?"²²

Clinical results are shown in Figures 7-10.

DISCUSSION

This study represents a large consecutive series of abdominoplasty procedures performed by 2 surgeons with a very similar operating technique, postoperative care routine, and philosophy on complications and revisions. Both surgeons used PTS in a very similar number and fashion. Although our technique naturally evolved somewhat over the 12-year study period, we made conscious efforts to maintain as much uniformity as possible.

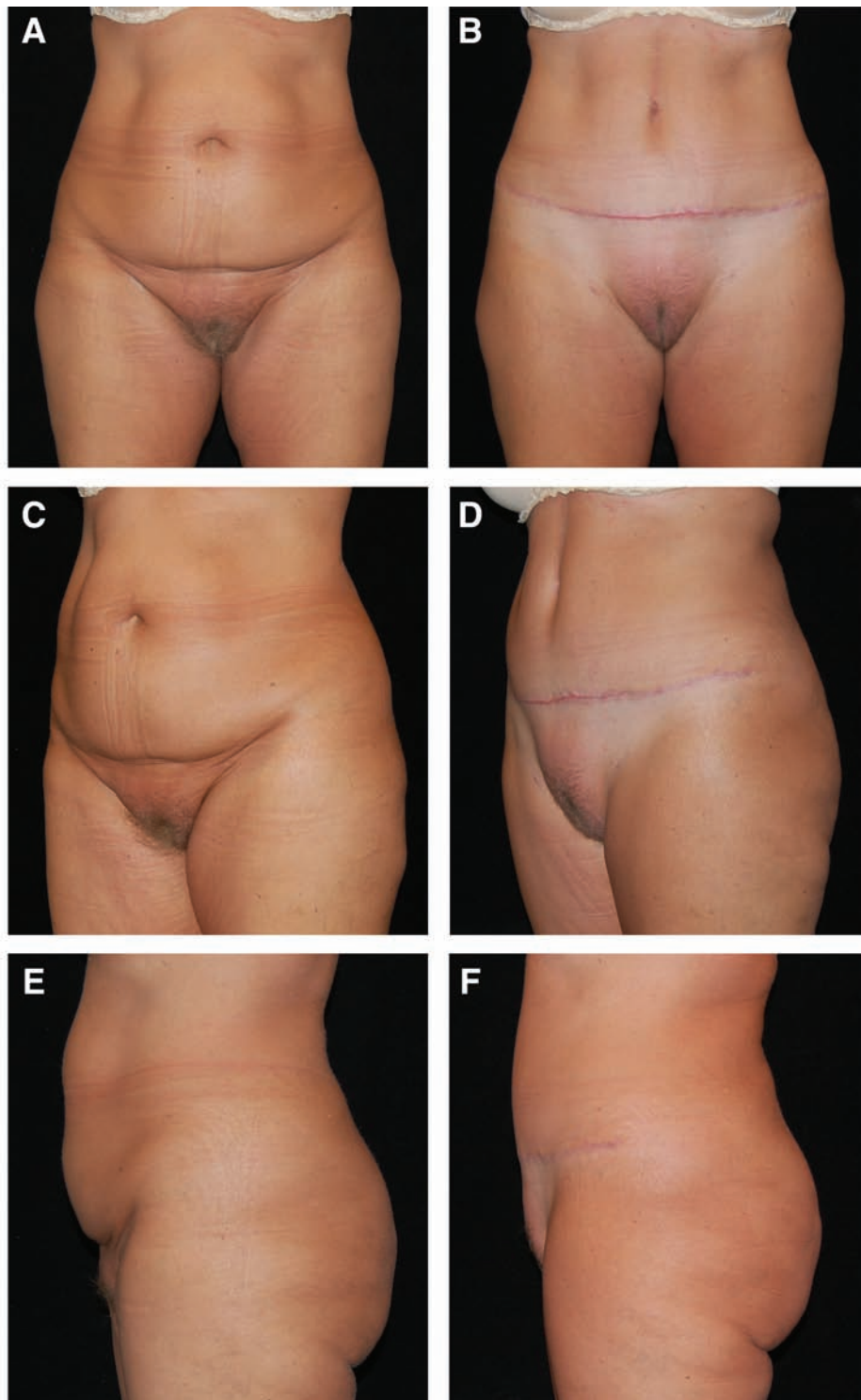


Figure 7. (A, C, E) This 35-year-old woman presented for full abdominoplasty with hip liposuction. (B, D, F) Three months postoperatively.

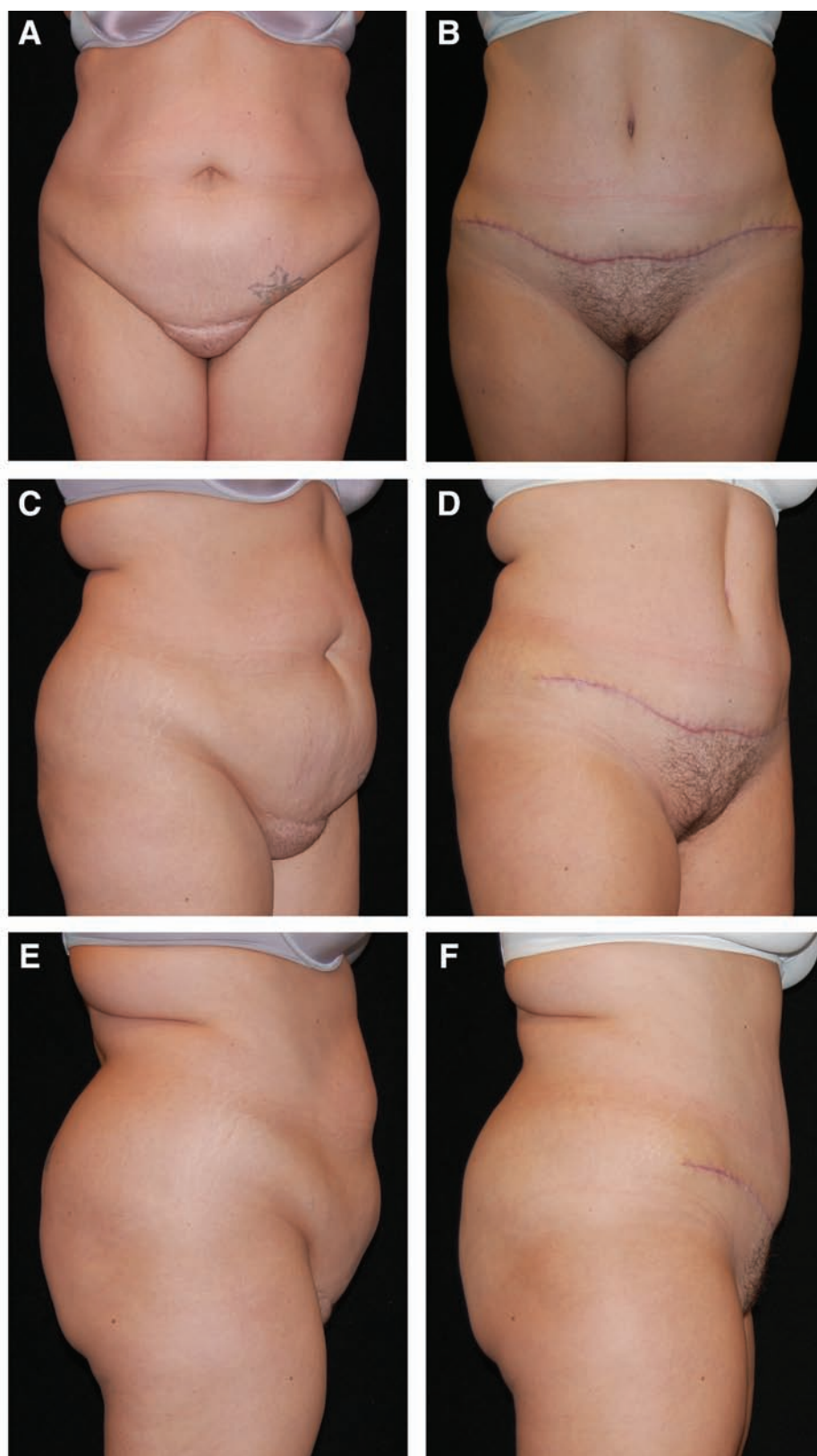


Figure 8. (A, C, E) This 32-year-old woman, who had 2 children by cesarean section, presented for full abdominoplasty with hip liposuction. (B, D, F) Three months postoperatively.

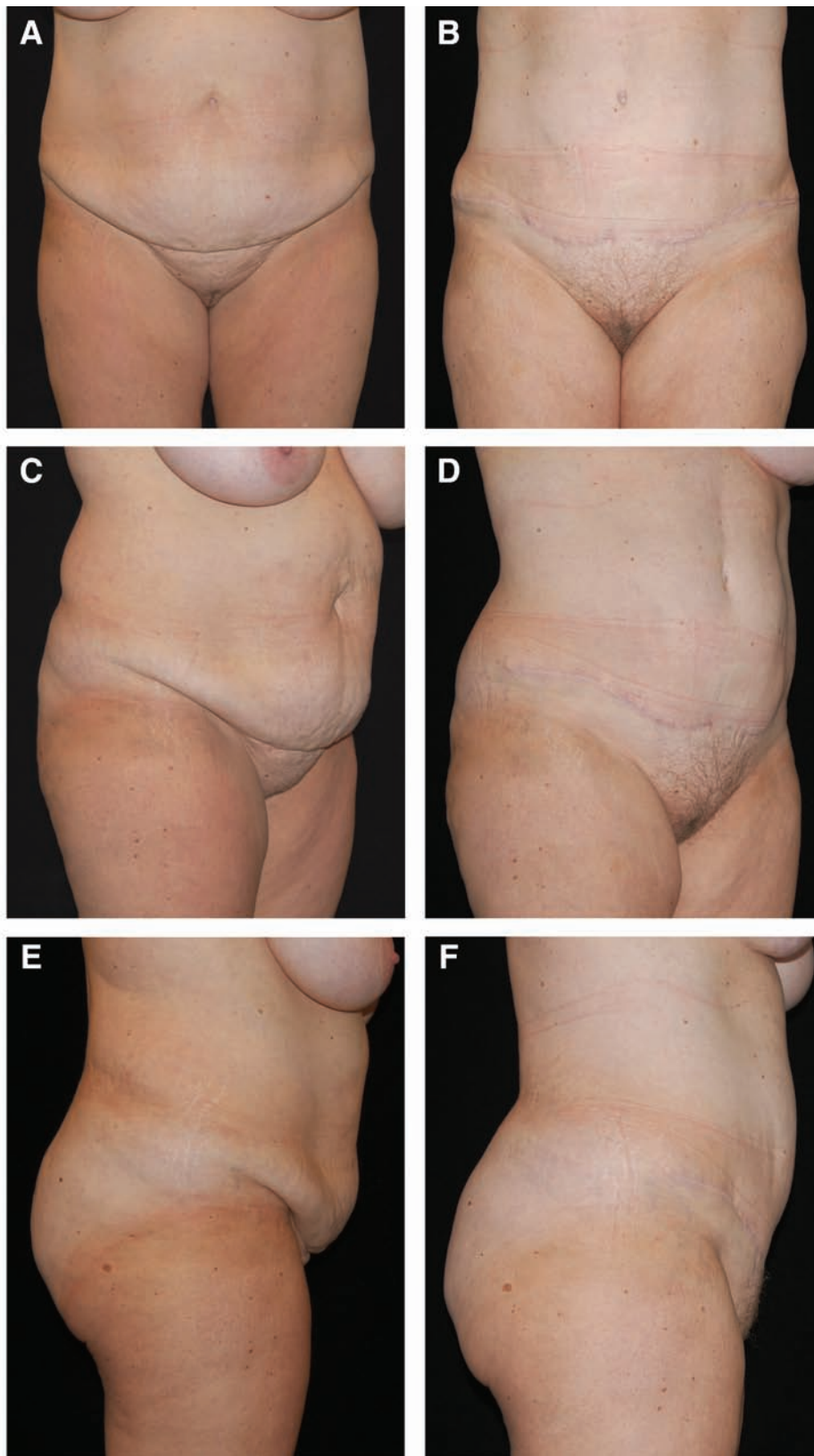


Figure 9. (A, C, E) This 42-year-old woman presented for full abdominoplasty, hip liposuction, and breast reduction. (B, D, F) Thirteen months postoperatively.

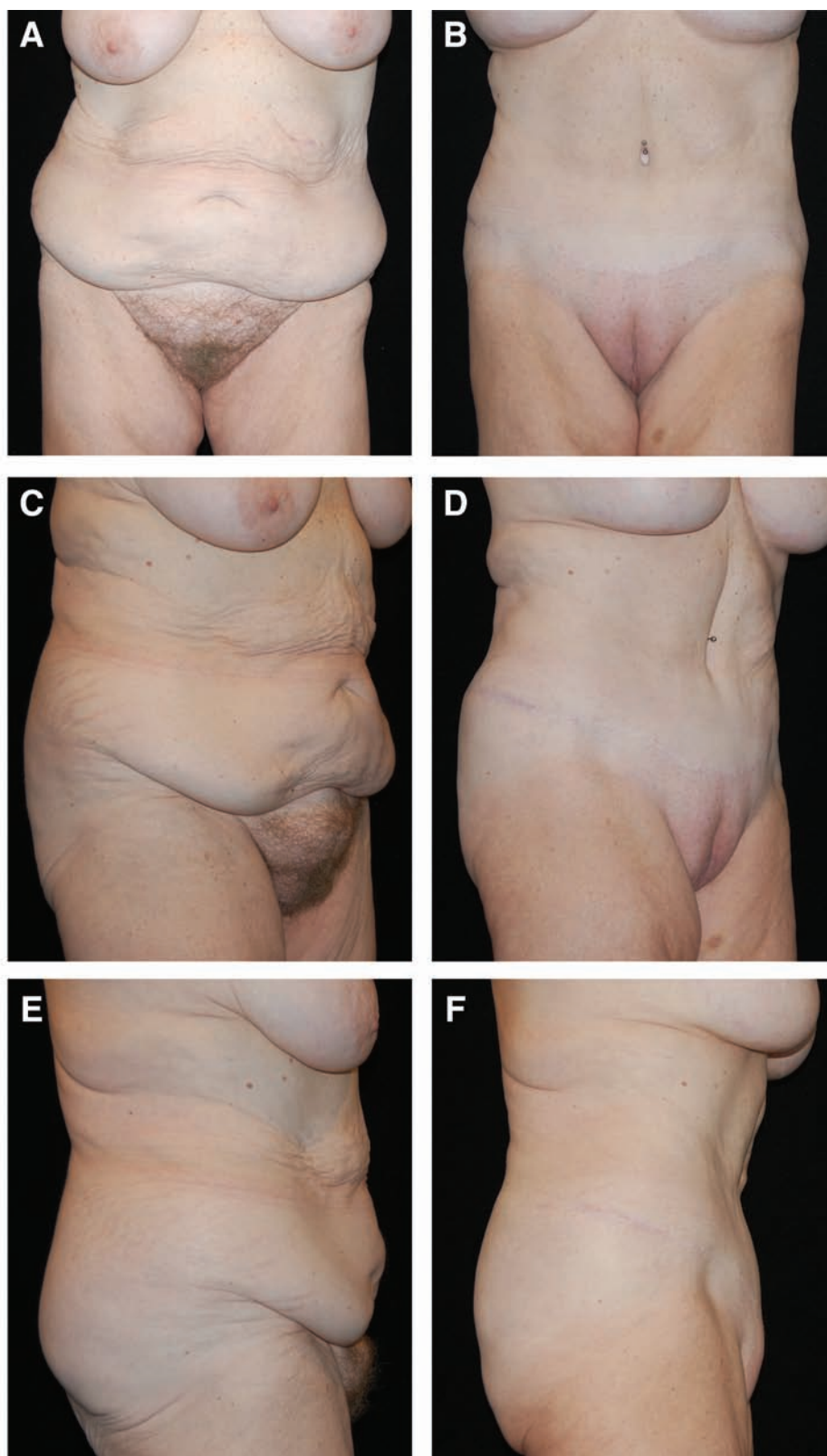


Figure 10. (A, C, E) This 56-year-old woman presented for abdominoplasty in conjunction with abdominal hysterectomy. She had lost 96 pounds following lap band surgery 2 years earlier. (B, D, F) Eighteen months postoperatively.

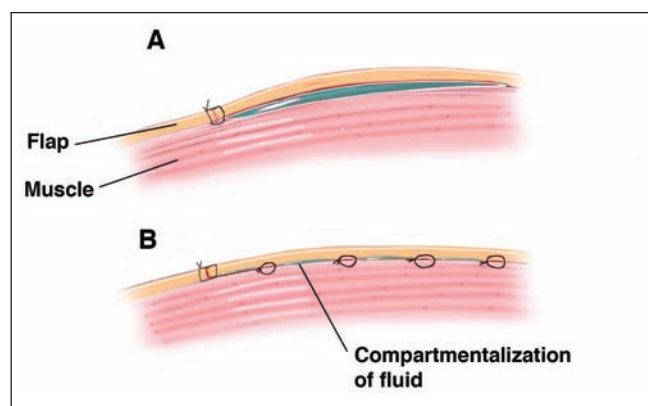


Figure 11. Cross-sectional illustrations of the advanced flap (A) without PTS and (B) with PTS show minimization of dead space and compartmentalization of the small amount of fluid that is present.

A significant finding in our study was the paucity of seromas relative to historic rates: just 1 occurrence among 597 cases. Although it is generally accepted that some form of seroma prevention is needed in abdominoplasty, the “best” technique is highly debatable. The suggested techniques for seroma reduction, in addition to PTS, are numerous and include limiting dissection,^{7,23,24} dissecting above the superficial fascia to avoid disruption of lymphatics,⁸ avoiding or limiting liposuction in conjunction with abdominoplasty, extending maintenance of the hip-flexed posture, postoperative immobilization, compression, use of plaster casts and weights,²⁵ and use of fibrin glues and drains. The etiology of seroma in general and in regard to body contouring remains uncertain but is likely multifactorial. Seroma reduction techniques can be grouped according to the specific seroma cause that they aim to prevent. For instance, if it is believed that the seroma occurring in abdominoplasty is caused by disruption of lower abdominal lymphatics, seroma could be avoided by dissecting above the superficial fascia in the lower abdomen.

Two etiologic factors are controlled by PTS: dead space and flap movement. Placement of these sutures obviously limits dead space under the large abdominoplasty flap, and ultrasound studies have shown small pockets of fluid (Figure 11). Nahas²⁶ noted that the volume of fluid collections averaged 8 mL, with the largest collections containing only 20 mL (confirmed by aspiration). In his series, no patient had a clinically significant fluid collection. Andrades et al,¹⁹ whose study is the only recent randomized, double-blind, controlled study involving PTS, observed a significant reduction in seroma with PTS relative to controls. Although ultrasonography may demonstrate small collections of fluid, in our experience these collections have not been clinically relevant and they resolve spontaneously without consequence. This compartmentalization also appears to be true for hematomas. When PTS are used, blood collections generally are localized and limited. As the

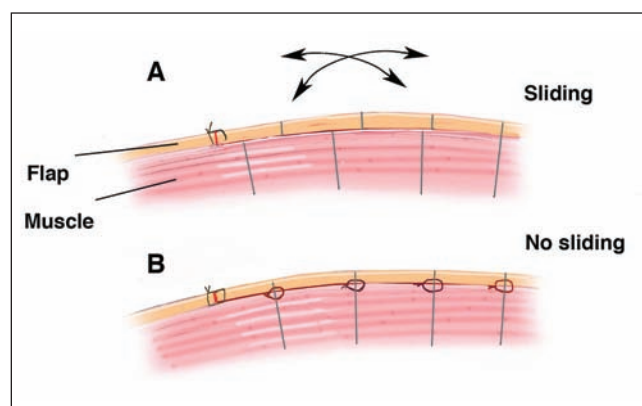


Figure 12. (A) When PTS are not used, abdominal movement causes the flap to shift relative to the underlying fascia. (B) When PTS are used, fixation of the flap is achieved and shifting is prevented. These are important factors in the prevention of seroma.

indications for anticoagulant chemoprophylaxis for VTE are broadened, this may become even more important.

Although reduction of dead space is important, we believe that flap immobilization is the primary mechanism by which fluid accumulation is minimized. PTS provide secure fixation of the flap to the muscle fascia, eliminating movement in the wide range of motion characteristic of the abdomen (eg, flexion, extension, rotation). Such motion could easily disrupt early healing between these tissue surfaces and result in increased inflammation. PTS placement securely affixes the 2 tissue planes together to resist disruption during early healing (Figure 12).¹⁸ In a study by Andrade, aspirated seroma fluid was analyzed at various times postoperatively showing that the fluid was initially an inflammatory exudate and only at about 2 weeks did it begin to resemble lymph in its makeup.²⁷ This indicates that inflammation plays a role in the etiology of seroma in abdominoplasty.

Several large studies have demonstrated that PTS are effective in reducing or preventing seroma. Antonetti and Antonetti²⁸ reviewed 516 abdominoplasties performed by a single surgeon. When PTS were used, the rate of seroma decreased from 24% to 1.7%. Trussler et al²⁹ reviewed their 20-year experience with 250 consecutive abdominoplasties, and noted 3 distinct phases. In their most recent study phase, which included placement of PTS (among other variations), the seroma rate declined from nearly 11% to 2.5%. This was largely attributable to the reduction in dead space and the secure flap fixation achieved by PTS.

Although PTS placement is not a challenging skill for surgeons to learn, there is a learning curve for placing the sutures efficiently. In particular, the surgeon must know how to most effectively use an assistant for visualization and reduce tension from the advanced flap while tying the knot. The sutures above the umbilicus are the most difficult and cumbersome to place, and this is where an assistant plays the largest role. Once a routine is established,

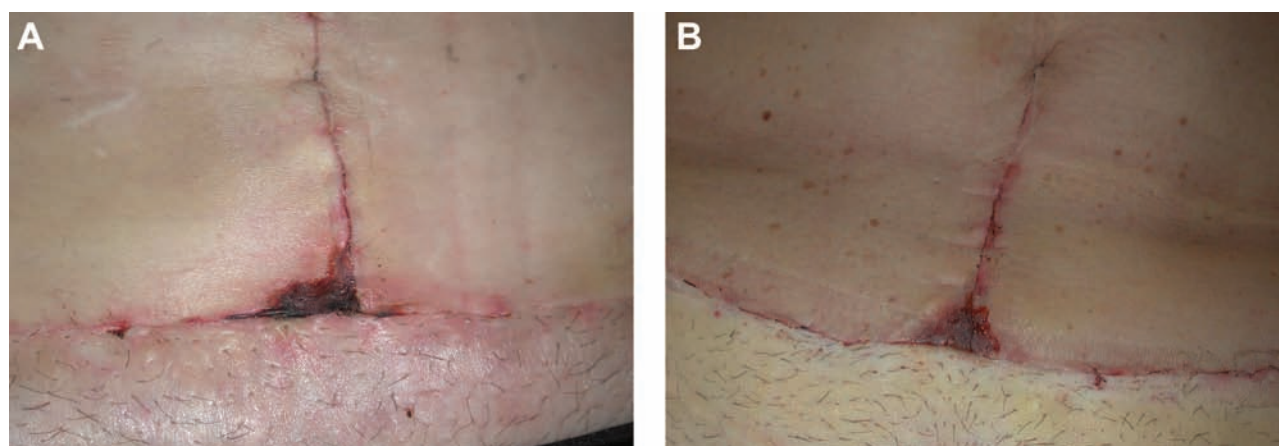


Figure 13. (A, B) Two patients with minor necrosis related to vertical incisions.

the placement of all PTS should take no more than 15 to 20 minutes. Others have developed technical modifications, such as the use of running barbed sutures, in an effort to expedite placement.^{30,31} However, individual sutures can be placed more precisely and removed more simply, if necessary. Regardless of suture technique (running or interrupted), it is important to understand that PTS placement is a technique for advancing and securing the flap—not an abdominoplasty technique in itself. PTS usage can be adapted to the surgeon's personal abdominoplasty operation, degree of undermining, use of liposuction, and so on.

Similarly, the surgeon must determine whether or not a drain should be used. We do not place drains of any kind. However, many surgeons do place drains when using PTS. Over time, as confidence in the technique is gained, the drains can be eliminated. In a randomized, controlled study, Andrade has shown that there is no advantage to using drains with PTS.¹⁹ Placement of the PTS is more difficult when drains are present, potentially increasing operating time and level of frustration. Another study³² compared abdominoplasty using “adhesion sutures” with and without drains. The incidence of seroma was minimal and did not differ between the study groups.

Skin-flap necrosis was minimal in our series, occurring in 4 patients. In 3 of these patients, the necrosis was related to a preexisting scar (2 vertical, 1 subcostal). In our opinion, old scars are a significant risk factor for necrosis (Figures 13 and 14). Following skin-flap advancement with PTS, the resected distal-flap edge appears to have excellent blood flow at the level of the dermis. We believe that the tension placed on the flap is transferred over a wide area to the superficial fascia and away from the subdermal plexus. However, this theory warrants further exploration.

There has been concern about the risk of seroma and flap necrosis being greater when liposuction is combined with abdominoplasty.⁶ In our study, two-thirds of the patients had liposuction of the flap itself or an adjacent area, with an average aspirated volume of just under

1L. These patients did not have a higher incidence of complications, which is supported by other studies.^{3,33} Khan³³ evaluated abdominoplasty with and without liposuction and PTS and found that PTS did reduce seroma. This statistic was not affected by the concurrent use of liposuction. Liposuction is often integral to achieving the desired aesthetic results in abdominoplasty, and when combined with PTS, it is evident that the incidence of seroma is not increased.

Over the period of our study, the use of modified or infraumbilical abdominoplasty decreased dramatically (Figure 6). We believe that this relates to greater confidence in the powerful flap advancement that can be achieved with PTS. For instance, a number of patients were difficult to categorize because they had limited upper abdominal skin excess, but too much to ignore. Earlier in our experience, we might have recommended a more limited procedure and hoped that the skin would contract with liposuction. Now we are more likely to recommend direct tightening by full abdominoplasty, knowing that PTS can safely achieve aggressive advancement.

VTE is a major concern in elective surgery, particularly for patients who undergo abdominoplasty. In fact, the modified Davison-Caprini risk-assessment model suggests that virtually every patient who undergoes abdominoplasty would require chemoprophylaxis.¹⁵ In our study, no deep venous thrombosis or pulmonary emboli were observed. Although we did not specifically review patient risk factors or modes of prophylaxis, our routine was to advise discontinuation of hormone therapy when practical, use sequential compression devices (begun prior to induction) on all patients, and have patients ambulate in an upright (nonflexed) position early after surgery. Chemoprophylaxis was used only in high-risk patients, which were uncommon in our practice.

The use of PTS may affect other factors suggested to elevate the risk of VTE in the abdominoplasty patient. Huang et al³⁴ measured intraabdominal pressure indirectly in abdominoplasty patients and found that it increased significantly with repair of rectus diastasis, use

of compressive binders, and flexed positioning (hips flexed at 30°). The elevated intraabdominal pressure is believed to decrease venous return and thus increase the risk of lower-extremity thrombosis. In abdominoplasty, repair of a widened rectus diastasis is often integral to the cosmetic result. However, with PTS we can decrease our dependence on tight compression devices and, maybe more important, get patients upright without concern for greater seroma risk or excessive tension on wound closure. Eliminating 2 of the 3 factors that appear to increase VTE risk in abdominoplasty may reduce the risk to that associated with non-body-contouring procedures and reduce the number of patients requiring chemoprophylaxis (with its inherent risks).

Importantly, the PTS technique yields a high level of patient satisfaction. Although satisfaction was not measured specifically in this study, we surmised that satisfaction was high because patients sought out the no-drain technique and described their postoperative experience as easier and quicker than that of friends who had drain placement. Many patients fear drains and are pleased to discover that drains are not needed with PTS. Moreover, postoperative instructions are simplified; patients may shower on postoperative day 2 and are encouraged to immediately increase activity in an upright position. Several studies support the use of immobilization following abdominoplasty.¹¹ At one time, orthopedic surgeons prolonged immobilization in patients following joint surgery, making recovery long and painful. Patients who are maintained in a flexed position after abdominoplasty become stiffer and experience a similar long, uncomfortable recovery. We conducted a small survey of 10 consecutively treated patients and asked when they were able to return to a full upright position. The average time was 2 days. Although this survey is not definitive and is limited by the small sample size, it indicates how quickly patients can safely and comfortably return to normal posture and activities.

CONCLUSIONS

In this 12-year abdominoplasty experience of 2 surgeons, PTS were used consistently and uniformly in all 597 patients. No drains were used, and other factors that have been associated with seroma were consistent among the study population (eg, abdominal liposuction; level, extent, and method of dissection; postoperative routine). Therefore, we attribute our minimal rate of seroma (and low rate of other complications) to the use of PTS. This technique appears to be an excellent adjunct in body contouring, avoiding the need to compromise aesthetics by limiting the degree of dissection or excluding concomitant liposuction. It is believed that the very low incidence of seroma is related to the reduction of dead space and secure flap fixation achieved with PTS. Complications such as hematoma, necrosis, and venous thromboembolic events also were minimal. Patient satisfaction was high because drains were avoided, rapid return to normal activities was achieved, and cosmetic results were excellent.

Disclosures

Dr Todd Pollock serves as a paid consultant to Ethicon and Johnson & Johnson (Somerville, New Jersey). Dr Harlan Pollock has no conflicts of interest to disclose.

Funding

The authors received no financial support for the research, authorship, and publication of this article.

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