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Breast

No-drain Technique in Abdominal Closure for Breast Reconstruction: Lower Complication Rate, Shorter Hospitalization Stay

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Background: Progressive tension suture (PTS) technique in cosmetic abdominoplasty is safe in terms of seroma rates. This was extrapolated to deep inferior epigastric perforator (DIEP) flap donor site closure. No study to our knowledge has analyzed the PTS technique alone without drains in transverse rectus abdominis musculocutaneous (TRAM) flap donor sites. We aim to show that no-drain closure has similar complication rates and this may be applied to TRAM flaps safely even though they have higher drain output.

Methods: A single-center, single-surgeon retrospective study was performed over 4 years. Patients undergoing breast reconstruction with an abdominal flap were included. Data collected included patient's demographics, type of flap, usage of drains or PTS technique, drain output, date of fitness for discharge, date of discharge, and seroma rates. The outcomes studied were drain volumes, seroma rates, and duration of hospital stay.

Results: Fifty patients were recruited. The first 25 patients (13 DIEP and 12 TRAM) underwent conventional closure. The subsequent 25 patients (17 DIEP and 8 TRAM) underwent PTS technique. TRAM flaps had higher drain volume (785.6 mL) compared to DIEP flaps (366.2 mL) ($P = 0.047$). No patients developed a seroma. Patients who underwent the PTS technique had lower abdominal-specific complications ($P = 0.021$). Patients without drains were discharged faster at 5.4 versus 8.2 days ($P \leq 0.001$).

Conclusions: Patients who underwent the PTS technique had lower complication rates, faster time to fitness for discharge and shorter hospitalization stay. The PTS technique may be applied to TRAM flaps safely. *(Plast Reconstr Surg Glob Open 2020;8:e2637; doi: 10.1097/GOX.0000000000002637; Published online 6 February 2020.)*

INTRODUCTION

The insertion of surgical drains is an age-old technique used across various specialties due to its many benefits such as evacuating existing accumulation of fluid, quantifying and qualifying drain contents, decreasing infection rate, and eliminating dead space.

Pollock and Pollock[1] were the first to publish their technique on progressive tension sutures (PTSs) in cosmetic abdominoplasty patients. In their retrospective review of 65 patients, the authors reported zero complications of hematomas or seromas. Their technique has since been reviewed by multiple authors[2–11] who corroborate their findings. Subsequently, the PTS technique was extended to perforator-based abdominal flaps for breast reconstruction[12,13] due to its similar characteristics to a cosmetic abdominoplasty. Nagarkar et al[12] performed a 3-year retrospective study by 2 surgeons and compared the method of deep inferior epigastric perforator (DIEP) abdominal closure. The first group had barbed running PTS without abdominal drains, the second group had interrupted PTS with abdominal drains, and the third group had abdominal drains only. Only 1 patient developed seroma who fell into the second group. Their results hence concluded that there was no difference in the rate of seroma formation. Liang et al[13] then quantified the mean drain output in patients with running barbed suture quilting sutures versus those without, with abdominal drain placement in both groups in DIEP abdominal closure. Their

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study showed that the group who had quilting performed demonstrated a significant decrease in mean drain output (238 versus 528 mL) and reduced the length of hospitalization. Rossetto et al[14] published their results comparing seroma rates in bipedicled transverse rectus abdominis musculocutaneous (TRAM) abdominal closure with quilting and drains versus drains alone. They found that the mean volume of drain output was significantly decreased with quilting by nearly half (393.06 versus 684.13 mL). No seroma formation was detected in the first postoperative month.

Previous studies showed that pedicled TRAM (pTRAM) flaps have a higher seroma rate compared to free DIEP flaps (8% versus 2.7%).[15] However, to date, no study has focused on comparing the actual drain output in TRAM flaps versus DIEP flaps. We hypothesize that TRAM flaps likely result in higher drain output as the rectus sheath is resected and reconstructed using a synthetic mesh as compared to DIEP flaps.

We therefore aim to show that the PTS technique results in comparable complication rates compared to conventional abdominal closure. We also want to ascertain whether the PTS technique may be used safely in TRAM flaps even though drain output is higher, which theoretically may increase the risk of seroma formation. Moreover, our local population tends to remain passive in managing their medical condition, and most patients prefer to be discharged only when all surgical drains are removed. We hence wanted to determine whether the absence of surgical drains accelerates patient recovery and discharge back to the community. This will help improve patient comfort in the immediate postoperative phase, decrease hospitalization stay, and hence cost for the patient.

PATIENTS AND METHODS

Study Design

A single-center, single-surgeon retrospective study was performed over a 4-year period from 2015 to 2018 in the KK Women's and Children's Hospital, Singapore. Consecutive patients undergoing breast reconstruction using abdominal flaps were included. These included pTRAM, free TRAM, free muscle-sparing TRAM (MS TRAM), and free DIEP reconstruction. Patient's data including age, weight, body mass index (BMI), smoking history, type of flap, the usage of abdominal drains or PTS technique, drain output of the first 25 patients, the date of fitness for discharge (FFD), the actual date of discharge, seroma rates, and other complications such as wound dehiscence and umbilical complications were collected.

The standard recovery regime from this surgeon is to allow the patient to sit up in bed postoperative day (POD) 1 and sit out of bed with ambulation on POD 2. We defined FDD as the post operative day the physiotherapist deems the patient to be competent in ambulation and discharges the patient from their care. Each patient was followed up for at least 6 months postoperatively.

The data were analyzed on IBM SPSS Statistics V23. Variables were analyzed using Fisher's exact test, chi-square test, analysis of variance, and Kruskal–Wallis test where appropriated. P value of <0.05 was taken to be statistically significant.

Surgical Technique

In the conventional abdominal closure group, multilayer closure using 2/0 Vicryl (Ethicon) for Scarpa's fascia, 3/0 Vicryl (Ethicon) for dermis and 3/0 Monocryl (Ethicon) for subcuticular closure is used. One Jackson-Pratt wound drain (Cardinal Health) is placed in each hemiabdomen.

In the PTS technique group, the surgeon in our study performs a modification of the previously described PTS technique.[1] Scarpa's fascia of the abdominal flap is quilted down to the rectus sheath using a running suture technique with a double-ended bidirectional-barbed suture—Stratafix Symmetric PDS (Ethicon) 2.0 taper point needle. In TRAM flaps, Scarpa's fascia is quilted down to the mesh on the affected hemiabdomen. Typically, only 2 sutures are required. The first suture begins at the apex of the abdominal flap superiorly and continues inferolaterally, and the second suture begins just inferior to the umbilicus in the midline and continues caudally toward the suprapubic incision line (Fig. 1). Additional sutures, however, may be needed if the patient has a long abdomen. In the presence of rectus divarification, plication of the rectus sheath is performed simultaneously. When suturing medially, midline interdigitation of the sutures on either side is performed. Particular care is required when suturing near the umbilicus. It is advised to leave a 1-cm circumferential cuff of rectus sheath unquilted around the umbilical stalk to avoid strangulation and resultant umbilical necrosis. The umbilicus should also be delivered before continuing the PTSs inferiorly as retrieval would otherwise be impossible if all sutures have been placed. Laterally, the abdominal flap is cinched to the lateral border of the rectus muscle. Once the suprapubic incision line is reached, a 3-point suture is performed between Scarpa's fascia of the abdominal flap, Scarpa's fascia at the inferior incision line and rectus sheath. Figure 2 illustrates the final placement of sutures which end at the incision line.

RESULTS

A total of 50 patients were recruited. The first 25 patients underwent conventional abdominal closure. The subsequent 25 patients underwent abdominal closure with PTS technique and no abdominal drains.

There were 26 DIEP flaps, 3 MS-1 TRAM flaps, 17 free TRAM flaps, and 4 pTRAM flap. We grouped the MS TRAM flaps together with the DIEP flaps as we were able to repair the rectus sheath primarily and did not require synthetic mesh placement. pTRAM flaps were grouped together with free TRAM flaps.

Both groups (conventional abdominal closure and PTS technique) had similar demographics. There was no difference in age (47 versus 44.4 years), weight (62.3 versus 60.5 kg), BMI (25.5 versus 23.8 kg/m^2), smoking history, and timing of reconstruction. The types of abdominal flap harvested in each group were comparable. We found that

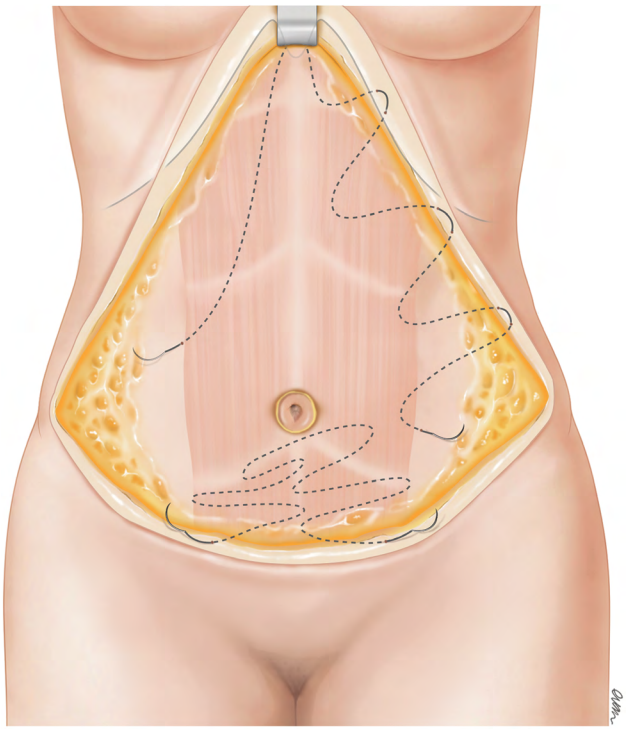

Fig. 1. Two sutures are typically used. The first suture begins at the apex of the abdominal flap. The second suture begins infraumbilical and continues to the incision line.

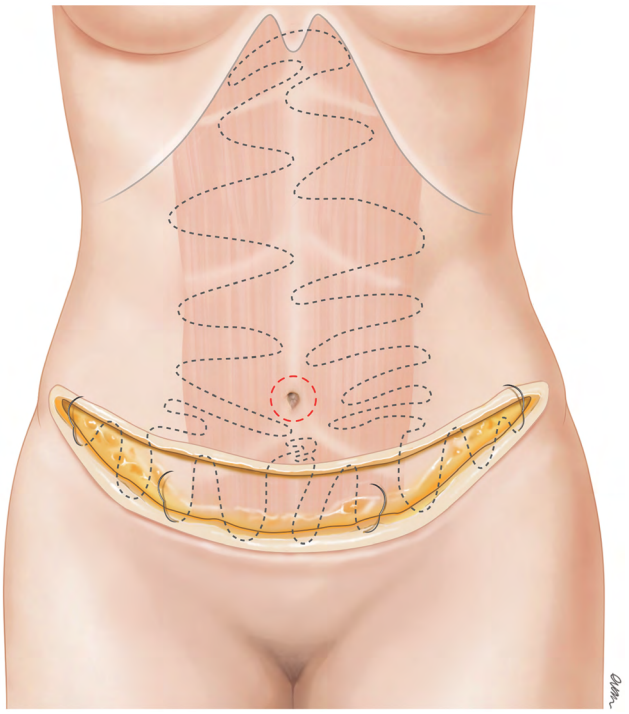

Fig. 2. Black dotted lines illustrate suture position. The superior suture shows midline interdigitation to recreate the linea alba as well as cinching of the lateral abdominal flap to the lateral border of the rectus muscle to recreate the linea semilunaris. At the incision line, a 3-point suture is performed between Scarpa's fascia of the abdominal flap, Scarpa's fascia at the inferior incision line and rectus sheath. Red dotted lines represent a 1-cm circumference around the umbilicus which is left unsutured to prevent umbilical strangulation.

although there was no statistically significant difference in operative time between the conventional abdominal closure group and PTS technique group at 653.9 versus 623.3 minutes, respectively ($P = 0.508$) (Table 1), the absolute average operative time in patients who underwent the PTS technique was shorter by 30 minutes.

Drain Output in TRAM versus DIEP Flaps

We analyzed the drain outputs in the conventional abdominal closure group to determine whether there was a difference between DIEP and TRAM flaps. The total abdominal drain output was significantly lower in the DIEP group at 366.2 versus 785.6 mL ($P = 0.047$) (Table 2).

Seroma Rates

In our study, no patient developed abdominal seroma in either group (Table 3).

Abdominal-specific Complications

Five out of 25 (20%) patients in the conventional abdominal closure group and 1 out of 25 (4%) of the PTS technique group developed complications specific to the abdominal wound. This included 2 patients with superficial wound dehiscence that were managed conservatively, 1 patient with delayed umbilical loss 1 month postoperatively, 1 patient who developed hypertrophic scarring, and 1 patient who developed abdominal hematoma that required surgical evacuation in the conventional abdominal closure group. In the PTS technique group, only 1 patient developed an abdominal-specific complication which was peripheral umbilical loss noted at POD 2. The rest of the umbilicus remained viable which was managed with dressings and the patient recovered uneventfully. The types of complications are summarized in Table 3. The rate of complications specific to abdominal closure was statistically significant between the 2 groups ($P = 0.021$).

FFD and Length of Hospitalization

We defined FDD as the post operative day the physiotherapist deems the patient to be competent in ambulation and discharges the patient from their care. Although not statistically significant, patients in the PTS technique group mobilized faster and were fit for discharge earlier at 4.5 days postoperatively compared to 5.6 days postoperatively in the conventional abdominal closure group ($P = 0.09$). However, we found statistical significance in the length of hospitalization (POD × day of discharge). Patients with abdominal drains remained hospitalized almost twice as long as those without abdominal drains at 8.2 versus 5.4 days ($P \leq 0.001$). In addition, patients in the PTS group went home almost as soon as they were fit for discharge with the difference in length of stay between FFD and day of discharge at 0.9 versus 2.6 days ($P = 0.005$). These findings are summarized in Table 4.

In all patients, the reason for continued stay despite being fit for discharge was the presence of abdominal

Table 1. Patient Demographics

Characteristics		Conventional Abdominal Closure N = 25	PTS Technique N = 25	*P*
Age, y		47 ± 7.66 45 (34–68)	44.4 ± 9.73 44 (33–69)	0.726*
Weight, kg		62.3 ± 11.9 60 (42–87.4)	60.5 ± 14.0 58.3 (43.1–114)	0.617*
BMI, kg/m^2		25.5 ± 6.3 23.8 (18.2–48.1)	23.8 ± 4.9 22.9 (17.5–39)	0.286*
Smoker	Yes	1 (4)	1 (4)	1.000†
	No	24 (96)	24 (96)	
Type of flap	DIEP	13 (52)	17 (68)	1.000†
	TRAM	12 (48)	8 (32)	
Timing of reconstruction	Immediate	24 (96)	24 (96)	0.455†
	Delayed	1 (4)	1 (4)	
Laterality	Unilateral	22 (88)	9 (100)	0.549†
	Bilateral	3 (12)	0 (0)	
Operative time, min		653.9 ± 156.3 641 (438–1,200)	623.3 ± 160.8 603 (346–1,138)	0.508*

Mean ± SD and median (minimum–maximum) for continuous variables; frequency (%) reported for categorical variable.
*The parametric *P* value is calculated by ANOVA for numerical covariates and chi-square test for categorical covariates.
†The nonparametric *P* value is calculated by the Kruskal–Wallis test for numerical covariates and Fisher's exact test for categorical covariates.
ANOVA, analysis of variance.

Table 2. Drain Output in DIEP versus TRAM Flaps

Type of Flap	DIEP N = 13	TRAM N= 1 2	*P*
Total drain output	366.2 ± 169.6 320 (190–725)	785.6 ± 698.1 561.5 (70–2,710)	0.047*

Mean ± SD and median (minimum–maximum) for continuous variables.
**P* value statistically significant.

drains. Only 8 of 25 (32%) patients in the conventional abdominal closure group went home with drains. Out of these patients, 5 went home with 1 drain and only 3 with 2 drains.

DISCUSSION

PTS Technique

Pollock and Pollock initially described the PTS technique using 3/0 Vicryl (Ethicon) braided absorbable sutures.[1] The advancement and suturing are repeated in the midline at intervals of approximately 1 cm. Lateral areas of the undermined flap are also sutured as needed to close the dead space and to secure the advanced flap. This suture advancement is continued to the level of the inferior wound edge. With this technique, they found that none of their patients experienced hematomas, seromas, or skin flap necrosis. Khan et al corroborated these findings using the same technique and suture placement but using 0 Vicryl (Ethicon) sutures.[4] Later on, barbed sutures were used instead of braided sutures due to the ability to perform continuous running sutures without the need for interrupted sutures. Regardless of the modifications, all studies concluded that the PTS technique reduces drain output and seroma rates. This is because PTSs significantly reduce the surface area between the abdominoplasty flap and abdominal wall. In addition, they minimize shearing forces that are postulated to contribute to seroma formation. From our study, despite TRAM flaps having a much higher drain output, none of our patients developed seromas.

One might suggest that objective evaluation with an ultrasound should be performed to determine whether there was a subclinical seroma formation. Although ultrasound would be able to detect subclinical seromas, this does not affect patient recovery and management especially if they are asymptomatic. The abovementioned patients were followed up for at least 6 months postoperatively. Seromas that cause infection would have been detected clinically.

Another advantage of the PTS technique is that it results in lower rates of wound dehiscence. Our results show that no patient (0%) in the PTS technique group developed abdominal wound dehiscence, whereas 2 out of 25 (8%) of patients in the conventional abdominal closure group developed wound dehiscence. We find that placing a 3-point suture at the incision line between Scarpa's fascia of the abdominal flap, Scarpa's fascia at the inferior incision line and rectus sheath takes significant tension away

Table 3. Seroma Rates and Abdominal-specific Complications

Complications		Conventional Abdominal Closure (N = 25)	PTS Technique (N = 25)	*P*
Seroma		0 (0)	0 (0)	NA
Abdominal-specific complications	Superficial wound dehiscence	2 (8)	0 (0)	0.021*
	Umbilical loss (complete/partial)	1 (4)	1 (4)	
	Hypertrophic scarring	1 (4)	0 (0)	
	Bleeding	1 (4)	0 (0)	

Frequency (%) reported for categorical variable.
**P* value statistically significant.

Table 4. FFD and Day of Discharge

Variables	Conventional Abdominal Closure N = 25	PTS Technique N = 25	*P*
POD × fit for discharge	5.6 ± 2.7 5 (3–15)	4.5 ± 1.6 4 (3–8)	0.09
POD × day of discharge	8.2 ± 3.4 7 (5–18)	5.4 ± 1.8 4 (3–10)	<0.001*
Difference in length of stay	2.6 ± 2.7 3 (0–13)	0.9 ± 0.8 1 (0–3)	0.005*

Mean ± SD and median (minimum–maximum) for continuous variables.
**P* value statistically significant.

from the wound. Furthermore, the surgeon advises alternating sutures between each hemiabdomen sequentially while progressing inferiorly toward the suprapubic incision line. This ensures equalization of tension on throughout the abdominal flap and incision line. Although one may argue that factors such as smoking or a higher BMI may confound this finding, both of our groups had similar smoking and BMI demographics as shown in Table 1.

It is known that patients with higher BMIs are more likely to develop complications. We are fortunate that the patients in our local population tend to be slimmer with an average BMI of 25.5 and 23.8 kg/m^2 in the conventional abdominal closure group and PTS technique group, respectively. However, we have patients in the PTS technique group with high BMIs of up to 39 kg/m^2. Regardless of this, our complication rate remained low.

Besides the benefit of decreasing seroma and wound dehiscence rates, the PTS technique has allowed us to simultaneously sculpt the abdomen by using one of the known complications of PTSs to our advantage, that is, skin dimpling. In our technique, we sculpt the abdomen by recreating the linea alba centrally and the linea semilunaris laterally. The linea alba is recreated when midline interdigitation of the sutures is performed as this prevents an unsightly bulge in the mid-abdomen. The linea semilunaris is recreated during cinching of the lateral abdominal flap to the lateral border of the rectus muscle. Cinching of the lateral abdominal flap toward the midline further defines a slimmer silhouette. The end result is an illusion of a toned muscle wall anteriorly and a narrow waist laterally (Figs. 3 and 4).

FFD and Day to Actual Discharge

A study by Beer and Wallner advocated a minimum of 48 hours of immobility as a strategy to minimize seroma rates after abdominoplasty.[16] In their study, they found that mobilization after 24 hours led to a seroma rate of 13%, whereas immobilization of at least 48 hours reduced the seroma rate to 0%. However, we find that this is not ideal as immobility may lead to deep vein thrombosis and pulmonary embolism requiring anticoagulation.

In our practice, we mobilize and ambulate our patients early from POD 2 onward. The main reason that limits patients from mobilization is discomfort from drain sites. Our data showed that patients without abdominal drains mobilized faster and were fit for discharge earlier at 4.3 days postoperatively compared to 5.6 days postoperatively in the conventional abdominal closure group with abdominal drains (P = 0.021). This is likely due to improved patient comfort in the immediate postoperative phase due to the absence of cumbersome abdominal drains. Moreover, our analysis showed that most patients in the PTS technique group were discharged on the same day the physiotherapist deemed them safe for independent ambulation with the mean difference in length of stay to actual day of discharge of 0.9 days (range 0–3 days). In contrast, patients with abdominal drains stayed longer despite being fit for discharge with a mean difference in length of stay of 2.6 days (range 0–13 days) (Table 4). This might be a unique problem to our population as our patients prefer to be hospitalized until all drains are removed.

Although we believe that discomfort from drain sites is the main limiting factor, we acknowledge that differences in analgesia usage may affect mobilization. Although analgesia usage was not analyzed in our study, all our patients usually receive a standard postoperative analgesia regime. This includes a continuous pump infusion of 0.25%

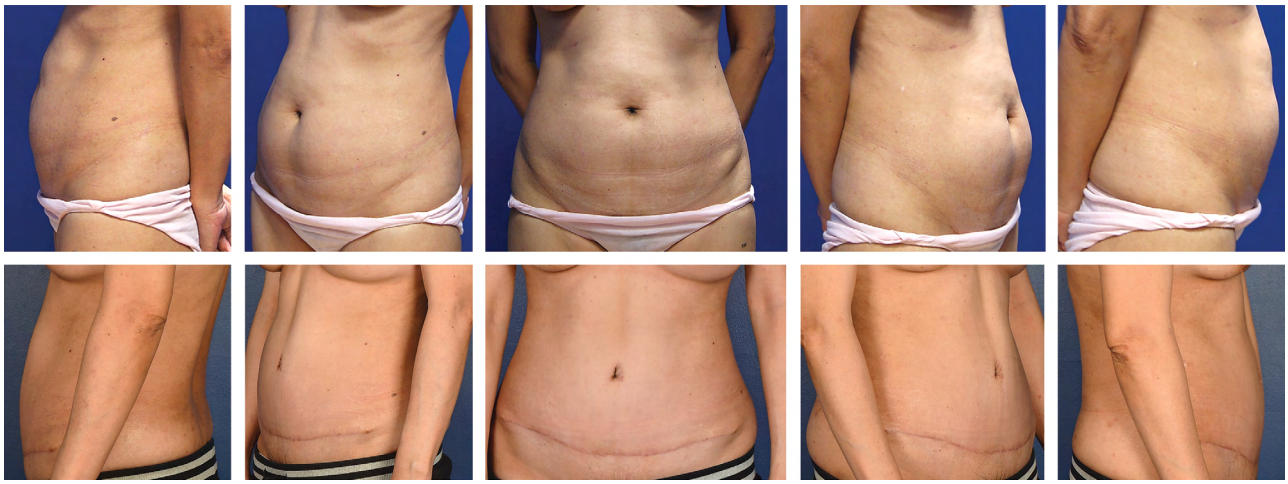

Fig. 3. Case illustration of a 53-year-old woman, BMI 24 kg/m^2. Top row: preoperative. Bottom row: 8 months postoperative showing maintenance of a slim waist and toned muscle appearance.

Fig. 4. Case illustration of a 43-year-old woman, BMI 28.1 kg/m^2. Top row: preoperative. Bottom row: 12 months postoperative showing maintenance of a slim waist and toned muscle appearance.

bupivacaine via an elastomeric pump at a preset flow rate (ON-Q PainBuster, B. Braun) inserted into the abdomen, patient-controlled analgesia with intravenous morphine, and oral paracetamol if there are no contraindications. Difference in analgesia is therefore possible, but unlikely.

CONCLUSIONS

The PTS technique is safe in TRAM flap closures with seroma rates comparable to those of conventional abdominal closure. Furthermore, it reduces abdominal-specific complications such as wound dehiscence, hypertrophic scarring, and bleeding. Patients in the PTS technique group had an earlier time to FFD hence a shorter hospitalization stay.

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