

# Decrease in Seroma Rate After Adopting Progressive Tension Sutures Without Drains: A Single Surgery Center Experience of 451 Abdominoplasties Over 7 Years

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## Abstract

**Background:** Abdominoplasty is a common aesthetic procedure in the United States. Pollock and Pollock described their progressive tension technique in 2000 and published a series of 597 patients in 2012 of their experience. The reported seroma rate in the literature ranges from 2% to 26% with drains and 0.1% to 4% with progressive tension sutures (PTS) without drains.

**Objectives:** Given these data, we decided to use PTS and forego drains in abdominoplasty. Here we present our experience with the transition.

**Methods:** This is a retrospective chart review of 451 abdominoplasties performed at our outpatient surgery center over a 7-year period (2009-2015). We gathered data on patient demographics, concomitant liposuction, and complications and length of follow up.

**Results:** Five main differences were examined in PTS vs traditional abdominoplasty using drains groups. These included rate of seroma, wound complication, scar revision, hematoma, and follow up. We found a decreased rate of seroma in the PTS group, 2% vs 9%. Wound complications were similar. Scar revision was slightly higher in the PTS group at 17% vs 10% in traditional abdominoplasty, this association had a *P* value of .048. The rates of hematoma were similar (0% vs 1%). The mean follow up was 6 months in PTS and 9 months in traditional abdominoplasty. Addition of liposuction did not increase the rate of seroma.

**Conclusions:** PTS without drains significantly decreased the seroma rate in our practice. Our experience adds to the mounting evidence that surgeons should consider using the PTS technique and abandon the use of drains in abdominoplasty. A well powered, multicenter, randomized controlled study is needed in order to definitively lay this question to rest.

## Level of Evidence: 4



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Abdominoplasty is the fourth most common aesthetic surgical procedure in the United States, according to statistics released by the American Society for Aesthetic Plastic Surgery in 2014.<sup>1</sup> This procedure is gaining in interest and certainly represents a large portion of plastic surgery practice. Despite mounting evidence that the use of drains in abdominoplasty may actually have higher seroma rates, many surgeons are reluctant to change their practice of using drains to adopting a procedure that eliminates their use.

Pollock and Pollock first reported the use of progressive tension sutures (PTS) in abdominoplasty in 2000,<sup>2</sup> and

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since then many have been interested in comparisons and outcomes with this technique. In their paper in 2012 with 597 cases, Pollock and Pollock reported a seroma rate of 0.1% and overall local complications of 4.2%.<sup>3</sup> Antonetti and Antonetti, as well as Khan, have noted decreased seroma rates after converting from abdominoplasty using drains to the PTS technique.<sup>4,5</sup>

Given the mounting evidence that the use of PTS without drains is safe and could reduce our seroma rate, we decided to start performing the procedure in our private practice in Marina del Rey, CA. In this study we examine our single American Association for the Accreditation of Ambulatory Surgery Facilities (AAAASF)- accredited outpatient surgery center experience transitioning from the use of drains to the use of PTS without drains in abdominoplasty.

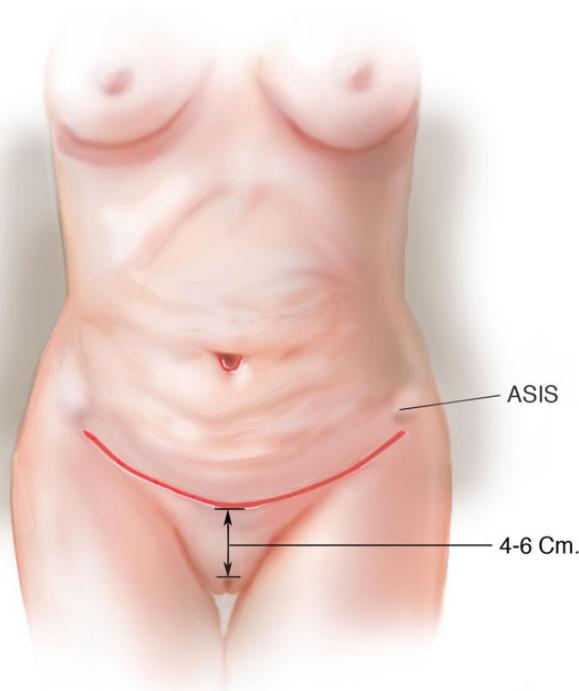
## METHODS

We performed a retrospective analysis of all abdominoplasty cases performed over a 7-year period from January 2009 to April 2015 by multiple surgeons in the practice. "Mini" abdominoplasties, where the flap was only elevated to the umbilicus rather than to the xyphoid, and circumferential body lifts were excluded from this study. It should be noted that during the study surgeons adopted the PTS technique;

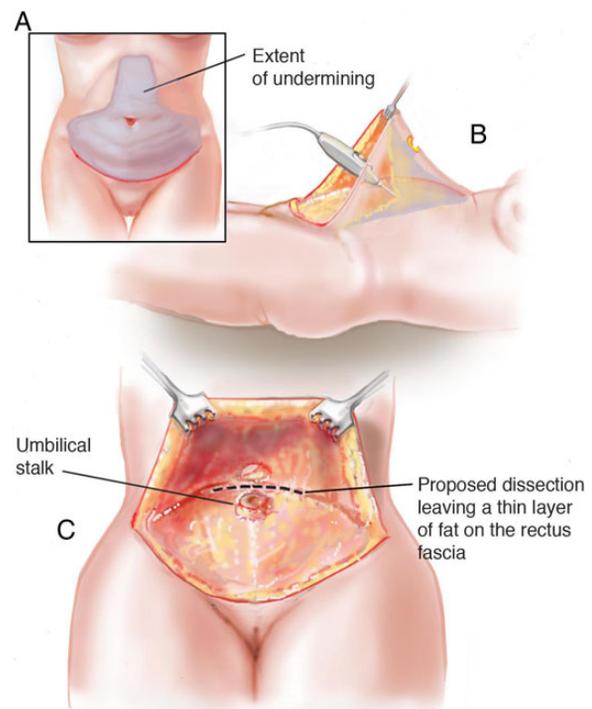
however, one continued the use of drains. Additionally, secondary abdominoplasties were also excluded.

During the 7-year period, there were 453 abdominoplasties performed by four attending surgeons. There was a gradual transition from the two techniques beginning in 2011 when one of the surgeons began utilizing the PTS technique. Over the course of the next three years, the overwhelming majority of the abdominoplasties being performed in the practice were utilizing the PTS technique. In the final study a total of 451 patients were included. Overall, there were 127 patients with PTS and 324 with traditional abdominoplasty. Two patients from the conventional abdominoplasty group were removed from the statistical analysis after their charts were found to lack data about follow up or postoperative care.

Patient demographic information was obtained from the chart, including age, gender, and body mass index (BMI). Comorbidities including diabetes and smoking history were obtained from the history and physical. The operative report was used to determine whether PTS were utilized vs Jackson-Pratt drains (Cardinal Health, Dublin, OH), and whether any related concurrent procedures such as liposuction were performed. Postoperative follow-up length and complications including seroma, hematoma, delayed wound healing, need for revision surgery, and pulmonary embolism/deep venous thrombosis (PE/DVT) were noted.



**Figure 1.** This illustration demonstrates preoperative markings, laterally these are well below the anterior superior iliac spine (ASIS).



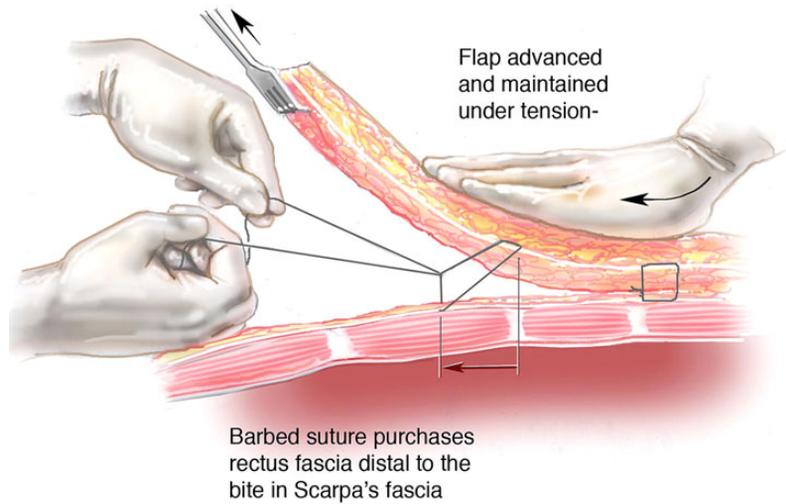
**Figure 2.** (A) The proposed dissection of the abdominal wall, up to the xyphoid process. (B) The extent of undermining and redraping of the abdominal tissues. (C) The abdominal wall and proposed redraped tissue, with a thin layer of abdominal fat, left on the abdominal wall.

This study was not IRB approved, but prior written consent was obtained from all of the patients who participated in this study. The study was conducted in accordance with the guidelines of the Declaration of Helsinki.

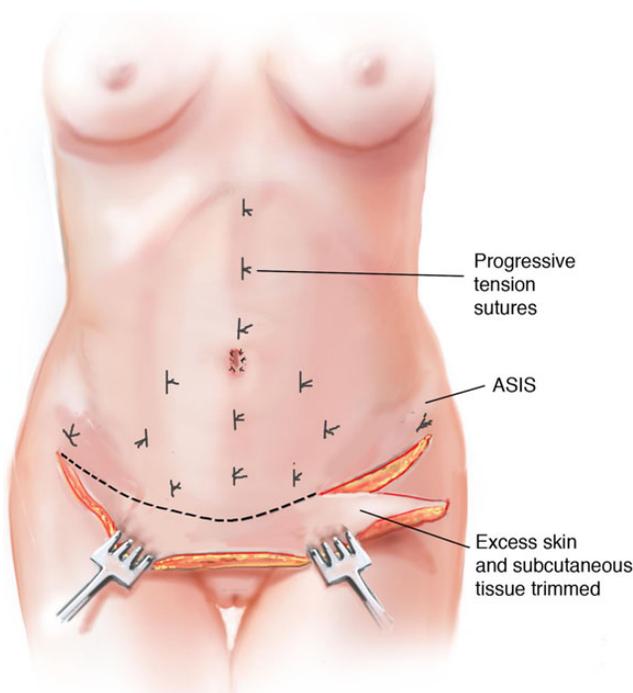
### Surgical Technique

The abdominoplasty incisions were marked in the standard fashion (Figure 1). The area to be liposuctioned and the planned incision lines were infiltrated with a tumescent

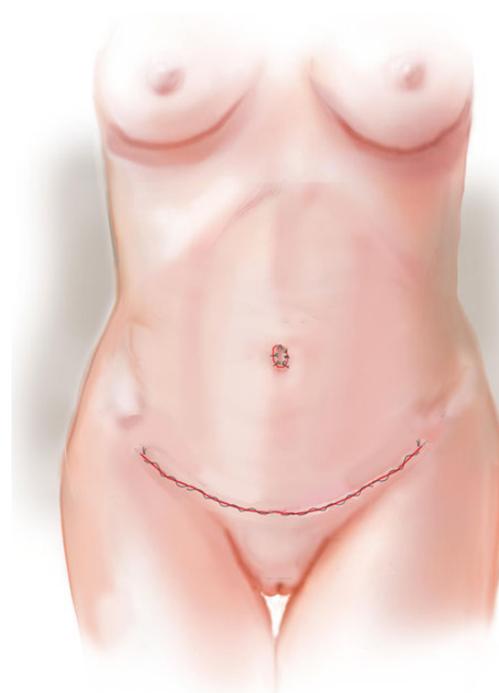
solution with lidocaine and epinephrine. In both the traditional and the PTS technique, the umbilicus was circumscribed and the infraumbilical skin was elevated off the anterior abdominal fascia using electrocautery (Figure 2). The elevation was carried supra-umbilically in a narrow dissection over the rectus muscles superiorly to the xiphoid process. The patient was then assessed for rectus diastasis and if noted, was repaired with either interrupted Tevdek II (Teleflex Medical OEM, Gurnee, IL) sutures or in a running fashion with a double-armed 0-PDO Quill (Surgical



**Figure 3.** This illustration demonstrates the technique of progressive tension suture placement.



**Figure 4.** This illustration shows the location of the progressive tension sutures.



**Figure 5.** This illustration shows the final abdominoplasty closure.

Specialties Corporation, Wyomissing, PA) sutures as this has previously been shown to assist in long-term abdominal tightness when laxity is present.<sup>6</sup> Once the rectus diasthesis was repaired (Figure 3), the lower excess tissue was excised. In the traditional technique, two Jackson-Pratt drains were placed exiting out the skin in the suprapubic region and the incision closed in a layered fashion. In the PTS group, 0-vicryl quilting sutures were placed in a progressive fashion along the midline (Figure 4). In the past other authors have also described the use of barbed sutures for this purpose.<sup>7</sup> The PTS sutures were placed in 2 to 3 points both supraumbilical and 2 infraumbilical in the mid-sagittal plane while providing aggressive inferior advancement of the abdominal flap. Additional lateral quilting sutures were placed in the infraumbilical region; usually 3 to 4 sutures per side, totaling 10 to 12 sutures in total. The incision was then closed in a layered fashion (Figure 5). Patients were required to wear an abdominal binder during the postoperative period.

## RESULTS

The demographics of the groups showed similar age with a mean PTS patient age of 44.1 years (range, 22-72 years)

**Table 1.** Patient Demographics

	Drains	PTS	P value
Number of patients	324	127	
Mean age (years)	44.3 (range, 19-71)	44.1 (range, 22-72)	.92
Mean BMI (kg/m <sup>2</sup> )	25.4 (range, 17-43)	26 (range, 18-37.9)	.17
Smoking	27 (8%)	9 (7%)	.70
Diabetes	4 (1%)	6 (5%)	.03

BMI, body mass index; PTS, progressive tension sutures.

**Table 2.** Complication Rates for the Different Groups

	Drains	PTS	P value
Number of patients	324	127	
Total complications	87 (26%)	38 (29%)	.55
Complications requiring revision	33 (10%)	22 (17%)	.054
Seroma	28 (9%)	3 (2%)	.021(s)
Wound complication	40 (12%)	19 (15%)	.53
Scar revision	31 (9.6%)	21 (16.4%)	.048(s)
Hematoma	3 (1%)	0 (0%)	.56
Mean (+/- SD) follow-up (months)	9.3 (+/- 11.4) (range, 1-69)	6 (+/- 5.9) (range, 1-32)	.001(s)

PTS, progressive tension sutures; SD, standard deviation.

and a mean traditional abdominoplasty patient of 44.3 years (range, 19-71 years) with a *P* value of .92 (Table 1). There were also similarities in mean BMI (26 kg/m<sup>2</sup> in the PTS group and 25.4 kg/m<sup>2</sup> in the traditional group; *P* value, .17) and in rates of smoking and diabetes (Table 1). There were 433 (96%) female and 18 (4%) male patients. Numerous patients also had liposuction in the flank/hip area (314 patients), abdominal flap (181 patients), and/or the mons area (23 patients). Some patients had liposuction in more than one area.

Five main end points were examined in the PTS vs traditional abdominoplasty groups. These included rate of seroma, wound complication, scar revision, hematoma, and follow up (Table 2). One of the most interesting findings was a significantly decreased rate of seroma in the PTS group, 2% vs 9%. This was verified with a Fisher's exact test, which yields a *P* value of .021. Wound complications were similar between groups and were not significant. However, scar revision was slightly higher in the PTS group at 17% vs 10% in traditional abdominoplasty, this association had a *P* value of .048 and was significant. The rate of hematoma was similar (0% vs 1%). The mean follow up was 6 months (range, 1-32 months) in the PTS group and 9.3 months (range, 1-69 months) in the traditional abdominoplasty group and there was a significant difference verified by a two-tailed *t* test (*P* value, .001). All of these findings are summarized in Table 2. In our series we had one patient admitted with postoperative hypoxia, but ruled out for DVT in the PTS group and we had one patient in the non-PTS group who flew postoperatively and one week after was admitted for PE/DVT and treated with Coumadin after this event. She developed symptoms after her flight, and not in the week after surgery, so it is unclear if her long flight contributed. We use sequential compression devices only as our surgeries are typically short in length.

We sought to identify whether there was any correlation between concurrent liposuction and seroma formation.

There were 186 patients who had liposuction in both PTS and traditional abdominoplasty groups and 266 who did not. Of these groups, 10 seromas occurred in liposuction patients and 22 in those without liposuction. The Fisher's exact test showed a *P* value of .26, which was not significant. We also looked for independent correlations between smoking and seroma, and actually found that 31 seromas occurred in non-smokers and 1 occurred in a smoker, thus there was no evidence here that smoking increased the rate of seroma.

Finally, we looked for a correlation between smoking and overall complications in the PTS and drain abdominoplasty groups. We found there were 27 smokers in the traditional abdominoplasty group, of whom only one had a wound complication and one had a seroma. There were 9 smokers in the PTS group and there was one wound complication and no seromas.

Interestingly, we again broke down our groups between PTS and traditional abdominoplasty and we found of those with traditional abdominoplasty, those who had no liposuction had 18 seromas and those that had liposuction had 10 seromas, there was no significant difference in seroma rate. Of those with PTS there were 3 seromas in patients who had no liposuction and no seromas in those who had liposuction. Most seromas occurred in a dependent fashion, however since this was a retrospective study we were limited in the data collection for the study. All seromas occurred in the abdominoplasty dissection plane, however there was no stratification as to if they were lateral, medial, or central.

Wound healing complications were noted in each group. These ranged from minor issues such as stitch abscess requiring incision and drainage and removal of stitch to skin loss and debridement of fat. The wound healing complication rate in the drain group was 12% (40 patients) and 15% (19 patients) for the PTS group (*P* = .53). Revision rates included all secondary procedures including revision of drain site scars, excision of standing cones, and scar revisions. The scar revision rate in the drain group was 9.6% (31 patients) and 16.4% (21 patients) in the PTS group and as stated above this was significant. The total number of all complications, including minor wound issues, medical complications and major surgical revisions was 38 patients or 29% in the PTS group and 87 patients or 26% in the drain group (*P* = .55). Although the revision rate for all secondary causes was higher in the PTS group, this did not reach statistical significance. When broken down into those complications which required surgical intervention, the total number was 22 patients or 17% in the PTS group and 33 patients or 10% in the drains group, and this was not deemed significant by the Fisher's exact test, with a *P* value of .054.

## DISCUSSION

Several key articles have presented support for the PTS technique, including the Pollock and Pollock paper and

another father and son team in Antonetti and Antonetti; both have reported great success with this procedure.<sup>2-4,8-10</sup> Antonetti and Antonetti reported a dramatic decrease in the rate of seroma from 24% to 1.7% with the use of PTS<sup>4</sup> without drains in their study. Khan showed that PTS reduced their risk of seroma from 26% to 4% overall.<sup>5</sup> Our study supports this downward trend and demonstrates a reduction from 9% to 2% seroma. One randomized prospective trial on the use of quilting sutures has been conducted by Andrades et al from Chile. They compared two groups of 15 patients and their findings showed that PTS increases operative time and there was no difference between use of drains alone and PTS in the rates of overall complications including seroma.<sup>11</sup> Unfortunately, the sample size was too small and in order to see differences in effect of 5%, a larger *N* value is needed. With a presumed rate of 10% in the standard group and 5% in the PTS group, there may be one or two patients in the group of 15 without PTS and one in the group with PTS and this would not represent statistically significant rates of seroma. In recently published studies, seroma rates are low enough that it may be difficult parse out significant differences in rates of seroma without large multicenter prospective trials. Regardless, they should be commended for their randomized prospective study in an effort to answer the question more definitively.

In the literature, reported seroma rates have been reported as highly variable, and range anywhere between 2% and 10%.<sup>12-17</sup> Seromas may be linked to several factors in abdominoplasty.<sup>5,18,19</sup> It may manifest from disruption of the lymphatics in the lower abdomen as others have shown the limiting dissection to a superficial plane may reduce the rates of seroma.<sup>20</sup> Seromas may also be an inflammatory mediated process<sup>18</sup> and has been shown to be linked to more traumatic procedures, including suction assisted lipectomy.<sup>19,21</sup> Other contributing factors may be dead space following the surgery and movement of the patient. Pollock and Pollock attribute their low seroma rate on the PTS keeping the flap from having shear movement against the anterior abdominal wall and thus preventing the formation of serous fluid.<sup>2</sup> In our patients we limited the dissection as much as possible and the dissection is carried out directly over the anterior abdominal wall. Perhaps leaving a layer on the anterior abdominal wall would and thus preserving the lymphatics would further decrease our overall seroma rate. This could be another variable to investigate in a large study.

Another advantage of not using drains is the avoidance of a scar from where the drain exits the body. Surgeons tend to either bring the drains out at the most lateral aspect of the incision or through the mons pubis area. With the recent trend of trimming hair very closely or completely removing pubic hair, these scars have become more unacceptable to the patient. If the drains exit from the lateral most portion of the incision, it has the advantage of possibly being removed with a standing cone excision if needed,

or of revising the scar without leaving an additional scar on the mons pubis. These scars are not a concern when using the PTS without drains. An additional purported advantage to the use of PTS is that it relieves tension from the incision and could lead to an improved quality of the scar. Interestingly, there is a higher revision rate in our PTS group than in the drain group which is not what was expected given the purported tension relief on the incision line with the PTS. This could be a future area for us to study as we obtain more patients with PTS who give us permission to use their photos for research and publication.

Obvious limitations in our study include the retrospective nature as well as having multiple surgeons involved. Since it is retrospective there could have been bias in the one surgeon who transitioned from drains to PTS in choosing low risk patients at the beginning of their experience and thus skewing the results in favor of the PTS. However, having multiple surgeons adds variables which we did not examine but it did also add some constants as 2 surgeons treated every patient with PTS and one surgeon treated every patient with drains. When we looked at the seroma rate for the one surgeon who transitioned, the seroma rate was no different. When we looked at the seroma rate for the two surgeons who only performed PTS and compared it to the surgeon who only performed abdominoplasty with drains, the seroma rates were similar to our findings. Thus one could argue that the surgeon who used drains may have a higher seroma rate in general due to intraoperative nuances or postoperative care differences. However, given the single center nature of the study, these did not vary much.

Smoking, BMI, or concomitant liposuction did not increase the complication rate or seroma rate. To investigate the potential for bias in the PTS group, the overall BMI was compared between the PTS and non-PTS patient groups. The investigative team wanted to ensure that there was no bias in the use of PTS without drains in larger BMI patients or larger liposuction cases which could have skewed the data in the favor to the PTS group. On examination of the demographics, the average BMI was found to actually be higher in the PTS group. Likewise the rates of liposuction were slightly higher in the PTS group, 87% of PTS patients had flank liposuction, 31% had abdominal liposuction, and 13% had mons liposuction, whereas in the non-PTS group, only 62% had flank liposuction, 43% had abdominal liposuction, and 2% had mons liposuction. This disproves the hypothesis that PTS had a lower rate of seroma because of differences in BMI or lower rates of liposuction.

On a pure anecdotal note, our patients and nursing staff and surgeons have felt that the postoperative recovery period is much less cumbersome for patients without drains; they have less wound care at home and are much more comfortable in their clothing, as would be expected when drains are not placed.

Despite some of the flaws in our study, it does add to the mounting evidence that abandoning drains in abdominoplasty in favor for PTS is safe and effective and will not contribute to an increase in the seroma rate, it may actually decrease it.

## CONCLUSIONS

The use of PTS without drains significantly decreased the seroma rate in our practice. Unfortunately, there is no level one evidence that proves that the use of progressive tension sutures without a drain has a lower seroma rate than using drains without any type of quilting suture. A well powered, thus likely a multicenter, randomized controlled study is needed in order to definitively lay this question to rest. However, our experience adds to the mounting evidence that surgeons should consider using the PTS technique and abandon the use of drains in abdominoplasty altogether.

## Disclosures

Dr Stevens is an investigator and speaker for Sientra (Santa Barbara, CA) and Silimed (Santa Barbara, CA); an investigator for Mentor Contour Profile Gel (Santa Barbara, CA) and Cohera Medical, Inc; a medical luminary and speaker for Solta Medical (Hayward, CA) and Zeltiq (Pleasanton, CA); a medical luminary for Cutera (Brisbane, CA), Merz (Greensboro, NC), Exilis (Framingham, MA), and Syneron-Candela (Irvine, CA); a speaker for Allergan Academy (Irvine, CA) and Cynosure (Westford, MA); and a consultant for TauTona (Menlo Park, CA). The other authors have nothing to disclose.

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