Abstract

Background: Tissue adhesives (TAs) are widely utilized in abdominoplasty to reduce postoperative seroma. However, current literature regarding TAs in abdominoplasty is limited to small studies and the findings of single institutions.

Objectives: The authors reviewed the current literature regarding the effects of TAs on seroma formation and other endpoints following abdominoplasty, and summarized the types of TAs and application techniques that have been described to date.

Methods: A systematic review of the Medline, Embase, Web of Science, and Cochrane databases was conducted to identify randomized controlled trials (RCTs) in which the numbers of patients who experienced seroma after abdominoplasty were indicated. The Cochrane Collaboration’s tool for assessing risk of bias was applied.

Results: Seven studies were included in a descriptive review, 5 of which were RCTs. Data from the 5 RCTs were pooled for a meta-analysis. Patients who received TAs following abdominoplasty had a similar incidence of seroma compared with patients who did not receive TAs. However, the total drainage volume was significantly lower for patients who received TAs.

Conclusions: There is a paucity of high-quality evidence to support the delivery of TAs to prevent seroma formation after abdominoplasty. Well-designed RCTs are needed to assess with confidence the overall effects of TAs in abdominoplasty.

Level of Evidence: 2

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have been proposed to reduce postoperative leakage at the surgical site, including the placement of drains,atraumatic handling of the skin flap, the placement of quilting sutures, the application of compression garments, and the delivery of tissue adhesives (TAs).

TAs are defined as substances with characteristics that enable the adherence of 2 substrates. Several mechanisms of action have been suggested for TAs. Some authors have proposed that TAs function as adhesive factors and hemothstatic purposes. The primary components of fibrin glue are thrombin and fibrinogen. The utility of fibrin glue as a TA in abdominoplasty was first reported in 2007 by Toman et al. These authors found that patients who received a slow-reacting fibrin sealant after abdominoplasty were less likely to experience seroma formation, compared with patients who received a fast-reacting fibrin glue or no fibrin glue. However, authors who subsequently applied fibrin glue and other TAs in abdominoplasty did not report consistently favorable results. The existing literature regarding TAs in abdominoplasty is limited to small studies and the findings of single institutions. To our knowledge, a systematic review of these studies has not been published. In the present review and meta-analysis, we evaluated the efficacies of various TAs to prevent seroma formation following abdominoplasty.

METHODS

The effect of TAs on seroma formation following abdominoplasty was the primary endpoint of this systematic review. Secondary analyses included the total volume of fluid drainage, the duration of drain placement, and the median hospital stay. In addition, the current types of TAs and the methods for TA delivery in abdominoplasty were evaluated.

Selection of Studies

On April 5, 2015, we conducted a review of published articles in the Medline, Embase, Web of Science, and Cochrane databases. The initial search was performed with no restrictions and with specific terms for TAs combined with specific terms for abdominoplasty (Appendix A, available as Supplementary Material at www.aestheticsurgeryjournal.com). All studies published on or before the search date in English, German, or French were evaluated for inclusion in this review.

After excluding duplicate articles, 2 authors of the present study (M. W. N. and S. F. J.) independently screened the titles and abstracts of all articles returned in the database searches. Candidate studies included evaluations of the effect of TA on seroma formation following any type of abdominoplasty. The full text of each candidate study was accessed for further evaluation, and the references list of each study was manually screened for additional pertinent articles. Candidate studies that were not accessible online were obtained by contacting the corresponding authors by e-mail.

For the meta-analysis, only randomized controlled trials (RCTs) in which the incidence of seroma after abdominoplasty was determined for patients who received TAs at the wound surface of the abdominal flap vs control patients who did not receive TAs. Excluded from the study were letters to the editor, studies that were not conducted in humans, studies in which the incidence of seroma was not clearly quantified, and studies that involved concomitant interventions, such as quilting sutures, to prevent seroma formation. All authors reviewed the full text of each candidate study and unanimously agreed on the final selection.

In addition, we performed a descriptive systematic review of the types and application of TAs in abdominoplasty. For this review, we included all articles related to TAs in abdominoplasty, including studies that were not RCTs and publications in which the number of patients who experienced seroma was not specified. Only letters to the editor and studies that were not conducted in humans were excluded from this assessment.

Data Collection

Data from each study were extracted and entered into 2 forms. For studies included in the meta-analysis, the following parameters were recorded: primary author, publication year, study design, type of abdominoplasty, number of patients, mean patient age, mean patient body mass index (BMI), patient smoking status, number of seroma cases, total drainage output, duration of drains in situ, median hospital stay, method for evaluating seroma formation, drain usage, and postoperative compression method. For studies included in the descriptive systematic review, the following parameters were recorded: primary author, publication year, study design, type of TA used, components of the TA, quantity of TA applied, and application technique.

Quality Assessment

For the meta-analysis, the methodologic quality of the studies was assessed according to the following criteria: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, proportion of patients lost to follow-up, inclusion and exclusion criteria, ethics approval, and declaration of conflicts of interest.
**Data Synthesis**

Review Manager software (RevMan, version 5.3, Copenhagen, Denmark) was utilized to compute a pooled effect estimate with a random-effects model for either binary or continuous outcomes. For dichotomous outcomes, the Mantel-Haenszel (M-H) method was applied to calculate the relative risk (RR) and corresponding 95% confidence interval (CI). For continuous outcomes, inverse-variance weighting was applied to calculate the mean difference and corresponding 95% CI. The effect estimate was determined by pooling the data abstracted from the individual studies. The weights of those results were determined by the variance of each trial estimate.

**RESULTS**

The initial search of the databases and the manual search of the references lists yielded 146 citations, 49 of which were duplicates. Of the 97 unique studies, 17 were selected as candidates based on assessments of titles and abstracts. Following the full-text review, 5 RCTs were selected for inclusion in the meta-analysis (Tables 1 and 2). Seven studies, including the 5 RCTs evaluated in the meta-analysis, were included in the descriptive review (Table 3). The Fleiss’ kappa was 1.0, indicating perfect agreement among the 5 authors of the present study. The stepwise approach for study selection is summarized in Figure 1.

**Meta-analysis**

**Demographic Characteristics and Reported Outcomes**

A total of 226 patients were recruited among the 5 RCTs, including 122 patients who were randomized to a TA group and 104 patients who were randomized to a control group. The types of surgeries included standard abdominoplasty (3 RCTs), lipoabdominoplasty (1 RCT), and circular lipoabdominoplasty (1 RCT). The mean age of control-group patients was 40.65 years, and the mean age of TA-group patients was 40.84 years. The mean BMIs were 28.94 kg/m² for patients in the control group and 28.91 kg/m² for patients in the TA group. Nineteen control-group patients (18.26%) were smokers, as were 31 TA-group patients (25.40%; Table 1). In all 5 RCTs, seroma incidence was the primary outcome. Three RCTs addressed total drainage output volume as a secondary outcome, and 2 RCTs included the number of drainage days and the hospital stay (Table 2).

**Risks of Bias**

For 3 of the 5 RCTs, the methods for random-sequence generation and allocation concealment were not described or the description was unclear. Therefore, these studies were considered to have a high risk or unclear risk of bias. Although randomization was noted in the reports of the other 2 RCTs, the type of randomization was not described. None of the surgeons in the 5 RCTs was blinded to the allocation of patients, owing to the nature

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Table 1. Demographic Characteristics of Patients Included in the Meta-analysis

<table>
<thead>
<tr>
<th>Study (year, Country)</th>
<th>Study Design</th>
<th>Type of Surgery</th>
<th>No. of Patients</th>
<th>Mean ± SD Patient Age (Range), Years</th>
<th>Mean BMI (Range), kg/m²</th>
<th>No. of Smokers (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mabrouk et al (2013), Egypt</td>
<td>RCT</td>
<td>LA</td>
<td>NTA 30</td>
<td>37.8 ± 9.1 (25-58)</td>
<td>38.5 ± 9.5 (31-55)</td>
<td>31.5 (32.7-37.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TA 30</td>
<td></td>
<td></td>
<td>32.6 (31.4-39.9)</td>
</tr>
<tr>
<td>Pilone et al (2015), Italy</td>
<td>RCT</td>
<td>CLA</td>
<td>NTA 15</td>
<td>35 ± 9.5 (NR)</td>
<td>38 ± 11.6 (NR)</td>
<td>36.4 ± 4.7 (NR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TA 15</td>
<td></td>
<td></td>
<td>36.2 ± 9.6</td>
</tr>
<tr>
<td>Schettino et al (2012), Brazil</td>
<td>RCT</td>
<td>A</td>
<td>NTA 20</td>
<td>41.8 ± 10.27 (28-60)</td>
<td>41.5 ± 10.97 (23-60)</td>
<td>23.4 ± 2.1 (19.5-26.1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TA 20</td>
<td></td>
<td></td>
<td>23.27 ± 2.2 (18.1-26.4)</td>
</tr>
<tr>
<td>Toman et al (2007), Germany</td>
<td>RCT</td>
<td>A</td>
<td>NTA 19</td>
<td>49 ± 11 (32-68)</td>
<td>28.7 ± 4.2</td>
<td>12 (63)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TA 19</td>
<td></td>
<td></td>
<td>NA</td>
</tr>
<tr>
<td>Walgenbach et al (2012), Germany</td>
<td>RCT</td>
<td>A</td>
<td>NTA 20</td>
<td>40 ± 10.1 (NR)</td>
<td>40.8 ± 9.3 (NR)</td>
<td>25.3 ± 2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TA 20</td>
<td></td>
<td></td>
<td>24.6 ± 2.8</td>
</tr>
<tr>
<td>Total</td>
<td>NA</td>
<td>NA</td>
<td>104</td>
<td>40.65</td>
<td>40.84</td>
<td>28.94</td>
</tr>
</tbody>
</table>

A, standard abdominoplasty; BMI, body mass index; CLA, circular lipoabdominoplasty; LA, lipoabdominoplasty; NA, not applicable; NR, not reported; NTA, the group of patients who did not receive tissue adhesives following abdominoplasty; RCT, randomized controlled trial; SD, standard deviation; TA, the group of patients who received tissue adhesives following abdominoplasty. *The study by Toman et al involved 2 groups of patients who received TAs; 1 group received TAs with a high concentration of thrombin, and the other group received TAs with a low concentration of thrombin.*
### Table 2. Results of Studies Included in the Meta-analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>NTA N (%)</th>
<th>TA N (%)</th>
<th>Mean Total ± SD Drainage Output (Range), mL</th>
<th>Mean ± SD Duration to Drain Removal (Range), Days</th>
<th>Median ± SD Hospital Stay, Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mabrouk et al31</td>
<td>11 (37)</td>
<td>1 (3)</td>
<td>NR</td>
<td>NR</td>
<td>5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pilone et al30</td>
<td>8 (53.3)</td>
<td>1 (6.6)</td>
<td>NR</td>
<td>NR</td>
<td>4.5 ± 1.5 1.5 ± 0.5</td>
</tr>
<tr>
<td>Schettino et al29</td>
<td>4 (20)</td>
<td>7 (35)</td>
<td>85.6 ± 52.11 (NR)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Toman et al28&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5 (26.3)</td>
<td>NA</td>
<td>79 ± 33 (40-190)</td>
<td>4 (3-7)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td>4 (22.2)</td>
<td>82 ± 45 (40-240)</td>
<td>NA</td>
<td>4 (3-6)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Walgenbach et al27</td>
<td>1 (5)</td>
<td>1 (5)</td>
<td>303.5 ± 240.8 (NR)</td>
<td>208.7 ± 138.23 (NR)</td>
<td>2.9 ± 1.4 (NR)</td>
</tr>
</tbody>
</table>

**Total incidence of seroma**

29 (27.88) 14 (11.47) NR NA NA NA NA NA

All included studies were randomized controlled trials. NA, not applicable; NR, not reported; NTA, patients in the control group who did not receive tissue adhesives after abdominoplasty; TA, patients who received tissue adhesives after abdominoplasty. The study by Toman et al28 involved 2 groups of patients who received TAs; 1 group received TAs with a high concentration of thrombin, and the other group received TAs with a low concentration of thrombin. No SD was reported.

### Table 3. Systematic Descriptive Review of Tissue Adhesives Applied in Abdominoplasty

<table>
<thead>
<tr>
<th>Study (Year)</th>
<th>Study Design</th>
<th>TA Type</th>
<th>Components</th>
<th>Quantity Applied</th>
<th>Technique of Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bercial et al48 (2012)</td>
<td>RCT</td>
<td>Quixil</td>
<td>Biologically active concentrate of human clottable proteins (40-60 mg/mL) and thrombin solution (human α-thrombin [800-1200 IU/mL] and CaCl [5.6-6.2 mg/mL])</td>
<td>4 mL</td>
<td>Sprayed with compressed air over the entire surface of the wound in a 1-mm-thick film</td>
</tr>
<tr>
<td>Lee et al16 (2012)</td>
<td>R</td>
<td>Tisseel</td>
<td>Fibrinogen (75-115 mg/mL), fibronectin (2-9 mg/mL), factor XIII (10-50 units/mL), plasminogen (40-120 μg/mL), aprotinin (3000 kIU/mL), thrombin (500 IU/mL), and CaCl (36-44 μmol/mL)</td>
<td>10 mL</td>
<td>Applied over the abdominal fascia before closure of the abdominal flap; after application of TA, 20 mL of human recombinant thrombin was applied (by spraying) for hemostasis</td>
</tr>
<tr>
<td>Mabrouk et al31 (2013)</td>
<td>RCT</td>
<td>Autologous PPP and bovine thrombin</td>
<td>Autologous PPP obtained by centrifugation, 0.2 mL of bovine thrombin for every 1 mL of PPP, and 0.1 mL of 10% CaCl</td>
<td>20 mL</td>
<td>Applied from the xyphoid process to the incision in 5-mL aliquots; pressure was placed on the abdomen after application of each aliquot</td>
</tr>
<tr>
<td>Pilone et al30 (2015)</td>
<td>RCT</td>
<td>Artiss</td>
<td>Human fibrinogen (91 mg/mL), synthetic aprotinin (3000 kIU/mL), human thrombin (4 IU/mL), and CaCl (40 μmol/mL)</td>
<td>10 mL</td>
<td>Sprayed under the abdominal flap before wound closure; the dispenser was held 10-15 cm from the abdominal wall; light compression then was applied for 5 min</td>
</tr>
<tr>
<td>Schettino et al29 (2012)</td>
<td>RCT</td>
<td>Autologous PPP and autologous thrombin</td>
<td>Autologous PPP obtained by centrifugation (protocol by Franco et al48) and autologous thrombin</td>
<td>NR</td>
<td>Application of PPP at room temperature within 4 h of activation with thrombin</td>
</tr>
<tr>
<td>Toman et al28 (2007)</td>
<td>RCT</td>
<td>Tissucol</td>
<td>High-concentration thrombin group received fibrinogen (70-110 mg/mL), fibronectin (2-8 mg/mL), factor XIII (10-50 units/mL), plasminogen (40-120 μg/mL), aprotinin (3000 kIU/mL), thrombin (500 IU/mL) for high-concentration group and 4 IU/mL for low-concentration group, and CaCl (36-44 μmol/mL)</td>
<td>4 mL for high-concentration group and 2 mL for low-concentration group</td>
<td>NR</td>
</tr>
<tr>
<td>Walgenbach et al27 (2012)</td>
<td>RCT</td>
<td>TissuGlu</td>
<td>Lysine-derived urethane</td>
<td>NR</td>
<td>Applied to the abdominal surface with a customized drop applicator before closing the flap; the abdominal flap then was reapproximated in a single motion</td>
</tr>
</tbody>
</table>

CaCl, calcium chloride; NR, not reported; PPP, platelet-poor plasma; PRP, platelet-rich plasma; R, retrospective study; RCT, randomized controlled trial; TA, tissue adhesive.
of the RCTs and the surgical techniques employed. Moreover, none of the 5 RCT reports addressed blinding of the patients or other personnel. Therefore, all 5 RCTs were classified as inadequate because of the high risk of bias.27-31

To assess the risk of bias for incomplete outcome data, we evaluated the incidence of seroma formation after abdominoplasty (ie, the primary outcome measure) for each of the 5 RCTs. We also determined whether an intention-to-treat (ITT) analysis was performed in each study and whether missing data were described and addressed. Most RCTs reports did not mention ITT analysis, nor did they include the number of missing participants or a description of the method to address the issue of missing participant data. Therefore, the risk of bias for all the RCTs was considered to be high.

To assess the risk of bias due to selective reporting, we examined the methods sections of each RCT report for descriptions of outcome measures. Although it was not possible to evaluate the protocol from which each RCT was derived, we concluded that all 5 RCTs carried a low risk of selective-reporting bias because each trial adequately addressed primary and secondary outcome measures.27-31

Three of the 5 RCT reports did not include statements of approval by an ethics board.28,29,31 However, all 5 included descriptions of any conflicts of interest and clear explanations of inclusion and exclusion criteria.27-31 The results of the meta-analysis and assessments of risk are summarized in Appendices B-D (available as Supplementary Material at www.aestheticsurgeryjournal.com).

**Effects of Interventions**

*Primary endpoint: incidence of seroma at the wound site*

Substantial heterogeneity was observed among the 5 RCTs with respect to the incidence of seroma ($I^2 = 66\%$).27-31 The results of the random-effects model indicated no difference in postoperative seroma rates between the TA group and the control group (RR, 0.42; 95% CI, 0.12–1.41; $P = .16$; Figure 2).

*Secondary endpoint: total volume of drained fluid*

There was no significant heterogeneity ($I^2 = 0\%$) among the 3 RCTs for which the volume of drained fluid was a secondary endpoint.27-29 The results of the random-effects model indicated that the total volume of drained fluid was significantly lower for patients who underwent abdominoplasty.
with placement of TAs in comparison to control patients in whom TAs were not applied (MD, −20.42; 95% CI, −36.18 to −4.67; *P* = .01; Figure 3).

**Descriptive Systematic Review**

The types of TA applied, the components constituting each TA, the volumes of TA applied, and methods of TA application are summarized in Table 3.

**DISCUSSION**

Seroma formation is a highly unfavorable complication of operations involving large cutaneous flaps.6,16,26,33-37 Seroma increases the risk of wound dehiscence and infection. If not treated promptly, seroma may lead to the development of a pseudobursa.30,38 Patients who experience seroma postoperatively must be treated for several sessions with needle aspirations and potentially with drain replacements or revisional surgeries.39 These procedures can increase morbidity and compromise cosmetic outcomes and patient satisfaction.27

TAs have been applied in numerous surgical procedures to prevent seroma formation. TAs placed following breast cancer surgery did not significantly decrease the incidence of seroma, but appeared to decrease the volume of fluid accumulated.26,40,41 Following harvest of the latissimus dorsi, TAs in combination with quilting sutures may prevent seroma formation.16 Various types of TAs have been utilized in abdominoplasty since 2007.27,28,30,31 Compared with other procedures for seroma prevention, TAs can be placed more quickly,23,27,42 and autologous TAs are more cost-effective.29 However, the cost-effectiveness of commercial TAs is debatable.30,43-45

We conducted a meta-analysis of 5 RCTs, which included 226 patients who underwent abdominoplasty with or without TA application during wound closure. Our results indicate that patients who received TAs experience seroma at a rate similar to that of patients who do not receive TAs. However, in our meta-analysis of the 3 RCTs that addressed fluid drainage patients who received TAs had a significantly lower drainage output than patients who did not receive TAs. The majority of RCTs included in the meta-analysis lacked adequate randomization techniques, allocation concealment, blinding, study power, and ethics approval (Appendix B, available as Supplementary Material at www.aestheticsurgeryjournal.com). Therefore, the quality of this evidence can be considered biased and inadequate.

In a randomized prospective study, Walgenbach et al27 utilized TissuGlu (Cohera Medical, Pittsburgh, PA), a lysine-derived urethane TA delivered with a specialized applicator, in patients who underwent abdominoplasty. These authors demonstrated that patients who received TissuGlu tended to require less time to drain removal compared with patients who did not receive TissuGlu. However, this finding was not statistically significant (2.9 ± 1.4 days and 3.7 ± 1.5 days to drain removal for the TissuGlu group and the control group respectively; *P* = .13).27 The authors suggested that statistical significance could potentially be achieved if the TA and control groups were larger.27 Only Pilone et al30 analyzed the effect of TA application on hospital stay following abdominoplasty; therefore, we were unable to conduct a pooled data analysis of this secondary endpoint. Pilone et al30 observed that the mean hospital stay for patients who received TAs after abdominoplasty (1.5 ± 0.5 days) was significantly shorter than the stay for control patients (4.5 ± 1.5 days); *P* < 0.01). We did not have sufficient data for a statistical analysis of either of these secondary endpoints.

In the present study, the TA group had a mean decrease in total drainage output of 20.42 mL (range, 4.67-36.18 mL) compared to the control group (*P* = .01). However, this difference may not be clinically relevant. For most patients who undergo abdominoplasty, drain removal does not occur until the follow-up visit at 1-week postoperatively. The decreased total drainage output observed in our meta-analysis would not influence the timing of drain removal or the hospital stay for these patients. However, for patients who are hospitalized postoperatively and undergo daily assessments of drainage output, the decrease in drainage output associated with TA placement could reduce the time to drain removal and the hospital stay. Patients for whom a threshold drainage output is set for drain removal (eg, drainage <30 mL/d or <50 mL/d) also could experience a reduced time to drain removal or a decreased hospital stay with TA placement.27,29-31

**Figure 3.** Forest plot summarizing the total drainage volume for patients who received tissue adhesives following abdominoplasty (TA group) vs patients who did not (NTA group), as determined in the present meta-analysis. IV, Inverse Variance method.
In 2007, Toman et al. described the efficacy of Tissucol (Baxter GmbH, Germany), a fibrin glue supplied as low-thrombin or high-thrombin formulations (ie, 4 IU thrombin/mL and 500 IU thrombin/mL, respectively), in patients who underwent standard abdominoplasty. Patients who received the low-thrombin TA had a significantly lower incidence of seroma compared with patients who received the high-thrombin TA or no TA (P < .018 and P < .032, respectively). In an RCT of 60 patients with grade 1 or 2 obesity, Mabrouk et al. demonstrated that patients who were randomly allocated to treatment with autologous platelet-rich plasma (PRP) after lipoabdominoplasty had a significantly lower incidence of seroma compared with patients who underwent lipoabdominoplasty and did not receive PRP (3% vs 37%, respectively; P < .05).

Pilone et al. evaluated the effect of Artiss (Baxter, Westlake Village, CA), a TA comprising human fibrinogen, synthetic aprotinin, and human thrombin, in patients undergoing circular abdominoplasty following bariatric surgery. These authors observed seroma formation in 1 of 15 patients (6.6%) who received the TA vs 8 of 15 patients (53.3%) in the control group (P < .01). In a retrospective case-control study, Lee and Mun reviewed 65 patients who underwent abdominoplasty following bariatric surgery. In some patients, Tisseel (Baxter) in combination with 20 mL of recombinant human thrombin was applied over the abdominal fascia. These patients experienced a significantly decreased rate of seroma formation compared with controls. Autologous platelet-poor plasma (PPP), obtained by centrifugation according to the protocol described by Franco et al., was applied in an RCT by Schettino et al. that included 40 patients. These authors found no significant difference in seroma rates between patients who received PPP (35% rate of seroma) and patients in the control group (20% rate of seroma; P = .288). Similarly, Walgenbach et al. found no statistically significant difference in seroma formation between patients who received TissuGlu and control-group patients. Bercial et al. monitored 43 patients who underwent abdominoplasty and were randomly allocated to 1 of 3 groups: abdominoplasty with suction drains alone (DN), abdominoplasty with quilting sutures (QS), and abdominoplasty with the fibrin sealant (FS) Quixil (Omrix Biopharmaceuticals, Tel Aviv, Israel). For patients in the FS group, Quixil was delivered by spraying the entire wound surface to obtain a film of TA (thickness, 1 mm). These authors found that the incidence of seroma and the seroma volume were significantly lower in the DN and QS groups compared with the FS group at 15 days postoperatively.

Several other TA types and techniques for TA application have been described previously but were not included in the present systematic review. Wattin and Van Loock utilized a spraying device to apply Tisseel (Baxter AG, Vienna, Austria) homogenously, covering a surface of 100 cm² with only 2 mL of solution. Oliver et al. delivered Beriplast P (Aventis Behring, UK) in patients who underwent abdominoplasty or dissection of the transverse rectus abdominis flap.

### Study Limitations

To our knowledge, the present study represents the first systematic literature review of the effects of TAs in abdominoplasty. The limitations of this study are associated with the variability of the RCTs included in our meta-analysis. For instance, 3 of the 5 RCTs involved ultrasound as a means to assess seroma postoperatively. In the other 2 RCTs, seroma was evaluated clinically. The number of drains and the types of compression garments applied varied across the 5 studies (Table 4), and several different types of TAs and application techniques were described (Table 3). Various types of operations were described in the 5 RCT reports, including standard abdominoplasty, lipoabdominoplasty, and circular lipoabdominoplasty (Table 1). Because data were sparse regarding the effects of TAs when applied to each of these surgical approaches, we pooled all these types of operations in our meta-analysis. However, pooling these data constituted a limitation of our study because these surgical approaches differ with regard to complication profiles. We could not group the RCTs by surgery type because lipoabdominoplasty and circular lipoabdominoplasty were each described in only 1 RCT report. A different type of TA was used in each study.

### Table 4. Interstudy Variability

<table>
<thead>
<tr>
<th>Study</th>
<th>Seroma Evaluation Method</th>
<th>Postoperative Compression and Drains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mabrouk et al.</td>
<td>US on postoperative days 10-12 and 18-21; results positive for seroma if &gt;20 mL fluid observed</td>
<td>2 drains removed when output was &lt;30 mL/d; compression garments for 4 weeks</td>
</tr>
<tr>
<td>Pilone et al.</td>
<td>US on postoperative day 15; results positive for seroma if &gt;20 mL fluid observed</td>
<td>Control group, 2 drains removed when output &lt;50 mL/d; TA group, drains were not placed</td>
</tr>
<tr>
<td>Schettino et al.</td>
<td>Clinical evaluation; no threshold volume to indicate seroma</td>
<td>Drains removed when output &lt;50 mL/d; patients advised to wear surgical support belt for ≥3 months</td>
</tr>
<tr>
<td>Toman et al.</td>
<td>US evaluation for 12 weeks; no threshold volume to indicate seroma</td>
<td>Drains removed after an average of 3 days (range, 1-7 days)</td>
</tr>
<tr>
<td>Walgenbach et al.</td>
<td>Clinical evaluation daily until both drains were removed and on postoperative days 14, 30, and 90 (&gt;3 days); no threshold volume to indicate seroma</td>
<td>2 Blake® drains removed when output &lt;30 mL/d; abdominal binder® placed postoperatively</td>
</tr>
</tbody>
</table>

CONCLUSIONS

There is a paucity of high-quality evidence to support or refute the utility of TAs for seroma prevention in abdominoplasty. There is considerable clinical and methodologic heterogeneity among RCTs addressing the effects of TAs in abdominoplasty on seroma formation, total drainage output, the duration of drain placement, and the hospital stay. Despite its limitations, the present meta-analysis provides guidance for clinical decision making and emphasizes the poor overall quality of available evidence for TAs in abdominoplasty. Further studies involving larger sample sizes and better comparability of interventions are warranted to assess with confidence the impact of TA in abdominoplasty.

Supplementary Material

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REFERENCES


