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Does Scarpa's Fascia Preservation in Abdominoplasty Reduce Seroma? A Systematic Review

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Abstract

Abdominoplasty is a widely utilized cosmetic surgery procedure. Despite its popularity, seroma formation remains a prevalent complication. Seroma can lead to extended recovery time, increased medical appointments, and the potential for infection or the need for additional surgical revision. Preserving Scarpa's fascia may mitigate the risk of seroma in patients following abdominoplasty. The goal of this systematic review was to determine the impact of preserving Scarpa's fascia on the occurrence of seroma and total drain output following an abdominoplasty procedure. This review searched academic literature in MEDLINE (via PubMed), EMBASE (OvidSP), and the Cochrane Central Register of Controlled Trials (CENTRAL) for clinical and observational studies published in peer-reviewed journals, from March 2022 to November 2022, that evaluated the impact of preserving Scarpa's fascia on postoperative seroma and total drain output during abdominoplasty. The primary outcomes of interest were seroma and total drain output, with secondary outcomes of interest including hematoma, time to drain removal, length of hospital stay, wound dehiscence, and infection rate. The systematic review of 8 studies, involving 846 patients, found that the preservation of Scarpa's fascia during an abdominoplasty procedure was associated with decreased seroma occurrence, reduced drain output, faster drain removal, and fewer infections. However, it did not affect the incidence of hematoma, hospital stay duration, or wound dehiscence. The preservation of Scarpa's fascia during an abdominoplasty procedure should be considered as a routine practice, because it has been shown to result in reduced seroma incidence rates and faster drain removal.

Level of Evidence: 4

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Abdominoplasty, also known as a “tummy tuck,” is currently 1 of the top 5 most frequently performed aesthetic surgical procedures in the United States.¹ As the number of bariatric surgeries increases, the number of patients experiencing significant skin excess and laxity of predominantly the abdominal area is also expected to rise, leading to an anticipated increase in the number of abdominoplasties in the future.² In fact, the number of abdominoplasties has already increased by 28% between 2012 and 2017, with a significant majority of patients being female.¹

Abdominoplasty has been shown to have a positive impact on self-image and quality of life, however it also has a relatively high complication rate.³ The most common complications are local and include seroma, hematoma, wound dehiscences, infections, and necrosis. Systemic complications, such as thromboembolic events, are less common.^{4–6} Seroma, defined as the accumulation of serous fluid between the abdominal skin flap and the rectus abdominis muscle fascia, is the most frequently reported complication, with rates ranging from 5% to 43%.^{7–11} Seroma can cause discomfort for the patient, require frequent outpatient visits with or without the need for aspiration, and may delay recovery. If left untreated, seroma can lead to the formation of a pseudobursa that may require surgical revision.^{11,12} Therefore, in the case of significant fluid accumulation, puncturing and draining are advised treatment options.⁴ The utilization of closed-suction drains at the end of an abdominoplasty procedure has been standard care for seroma prevention; however, this method has the disadvantage of causing postoperative pain and increasing the risk of infection, especially when the time to drain removal is extended.^{6,10,13,14} The formation of a “dead space,” shearing forces between the abdominal flap and fascia, and the disruption of lymphatic vessels are thought to contribute to seroma formation following an abdominoplasty procedure.^{8,15} Currently there is a lack of hard evidence concerning the impact of lymphatic disruption on seroma formation.

Multiple methods have been adopted to reduce the incidence of seroma after an abdominoplasty. These methods include multiple dissection techniques (ie, electrocautery dissection, scalpel dissection, and plasma-kinetic energy-based dissection), lipoabdominoplasty procedures, Scarpa's fascia preservation, quilting sutures or progressive tension sutures (PTS), closed-suction drains, adhesives or fibrin glue, postoperative immobilization, and compression garments.^{11–28} A recent study by Seretis et al showed that performing abdominoplasty with Scarpa's fascia preservation, tissue adhesives and, possibly, PTS could independently reduce seroma rates.¹¹ Scarpa's fascia preservation is believed to be effective because it spares the lymphatics that are located near the fascial planes rather than in the adipose tissue itself.²⁹ The importance of avoiding the lymphatics of the femoral triangle during a lower body lift to minimize complications has

Table 1. Specific Search Terms in Databases

| Database | Search terms |
|---|--|
| MEDLINE (via PubMed, National Institutes of Health; Bethesda, MD) | ((Abdominoplasty [Mesh] OR Tummy tuck [tiab] OR Panniculectomy [tiab]) AND (Scarpa's fascia [tiab] OR Scarpa fascia [tiab]) AND (Seroma [tiab] OR Drain [tiab] OR Complication [tiab])) |
| EMBASE (OvidSP; Elsevier; Amsterdam, the Netherlands) | (('abdominoplasty':ab,ti OR 'tummy tuck':ab,ti OR 'panniculectomy':ab,ti) AND ('Scarpa's fascia':ab,ti OR 'Scarpa fascia':ab,ti) AND ('seroma':ab,ti OR 'drain':ab,ti OR 'complication':ab,ti)) AND [Embase]/lim NOT [Medline]/lim AND 'article'/it) |
| Cochrane Library (CENTRAL, Wiley; Hoboken, NJ) | ((abdominoplasty OR tummy tuck OR panniculectomy) AND (Scarpa's fascia OR Scarpa fascia) AND (seroma OR drain OR complication)) |

been previously highlighted by Lockwood, and Le Louarn has also previously demonstrated the effectiveness of sparing the fascia of Scarpa in reducing seroma incidence rates following an abdominoplasty procedure.^{17,18,30}

This systematic review aimed to evaluate the effect of Scarpa's fascia preservation on seroma incidence and total drain output after an abdominoplasty in randomized and prospective or retrospective controlled trials.

METHODS

Protocol and Registration

This systematic review was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, and the search strategy was based on a population, intervention, comparison, outcome (PICO) framework.^{31,32} This study was not registered.

Eligibility Criteria

Randomized and prospective or retrospective controlled studies were included if patients underwent an abdominoplasty with Scarpa's fascia preservation to evaluate seroma rates. Inclusion of a control group of patients that underwent an abdominoplasty without Scarpa's fascia preservation was required. All case reports and reviews were excluded. Searches were not limited by publication date, language, or publication status ([Supplemental Table 1](#)).

Search Methods

MEDLINE (via PubMed, National Institutes of Health; Bethesda, MD); EMBASE (OvidSP, Elsevier; Amsterdam, the Netherlands); and the Cochrane Central Register of

Controlled Trials databases (CENTRAL, Wiley; Hoboken, NJ) were searched (from March 2022 to November 2022; Table 1). The search terms were based on 3 components: abdominoplasty, tummy tuck, panniculectomy (population); Scarpa's fascia, Scarpa fascia (intervention); and seroma, drain, complication (outcome).

Data Collection and Analysis

Two of the authors (NS and JAD) performed the search independently. Disagreements were discussed during a consensus meeting. In case of discrepancies between the 2 authors, the senior author (BL) gave a binding verdict.

Data Items

The search terms were based on a PICO framework. Comparisons were not included in the search terms. For comparison we employed abdominoplasty without Scarpa's fascia preservation. Eligible studies were further divided into 2 different outcomes: primary and secondary. Primary outcomes of interest were seroma and total drain output. Seroma was defined as a clinically palpable fluid collection. Secondary outcomes of interest were hematoma, time to drain removal, length of hospital stay, wound dehiscence, and infection rate. Study characteristics were described.

Risk of Bias of Individual Studies and Across Studies

Demographics of the included patients were described. The included studies were evaluated for financial support. Disclosure agreements were reviewed for each study.

Statistical Analysis

Data were analyzed with IBM SPSS Statistics Version 28 (Armonk, NY). Comparisons for dichotomous outcomes (seroma, hematoma, wound dehiscence, and infection rate) were performed with an unpaired *t* test. Statistical significance was defined as a 2-tailed *P* value of less than .05.

Quality Control of Included Studies

The included studies were graded on quality of evidence with the Oxford Centre for Evidence-Based Medicine criteria.³³

RESULTS

Included Studies

In total, 39 studies were identified by database screening. Thirty were excluded after abstract screening. One study

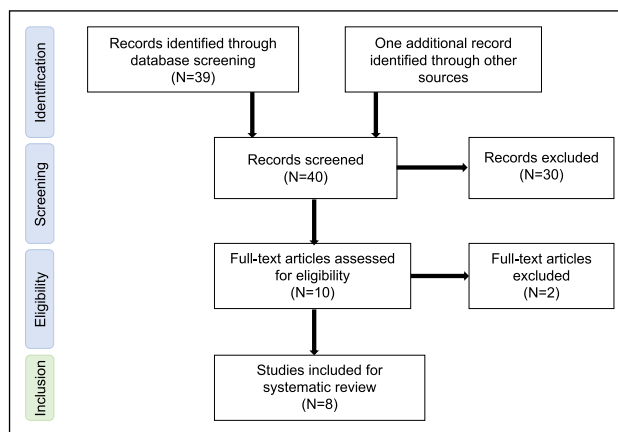


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Flow Diagram.

that met our inclusion criteria was added through other sources. Ten full-text studies were assessed on eligibility criteria. Two studies were excluded because they were not controlled studies or lacked a group that included the preservation of Scarpa's fascia. Ultimately, 8 studies were included in this systematic review (Figure 1).

Study Characteristics

In total, 846 patients were enrolled in the 8 studies.^{34–41} The 8 studies were conducted in Portugal, Brazil, Austria, Egypt, and Israel.^{35–41} Five of the articles included a randomized controlled trial, and 3 of the articles included a retrospective comparative study.^{34–41} All studies included a group with Scarpa's fascia preservation and a control group that underwent classical abdominoplasty or fleur-de-lis abdominoplasty (without Scarpa's fascia preservation).^{34–41} In 1 study the abdominoplasty was combined with the correction of an abdominal herniation, and in another study PTS were utilized in both the Scarpa's fascia preservation group (supraumbilical and infraumbilical PTS) and the control group (supraumbilical PTS; Table 2).^{39,41}

Patient Characteristics

Seven studies reported gender, which was 99% female. The mean age of the participants was approximately 40 years, and 7 studies required a preoperative BMI below 30. One study reported a mean preoperative BMI of 36.6.³⁹ Six studies reported patients with a history of bariatric surgery. The reported follow-up varied from 18 days to 12 months (Table 2). Primary outcomes of interest were seroma and total drain output. Secondary outcomes of interest were hematoma, time to drain removal, length of hospital stay, wound dehiscence, and infection rate (Supplemental Table 2).

Table 2. Study Characteristics and Patient Demographics of the Included Studies

| Reference | Study type | Intervention | Method of dissection | Tissue resection mass (g) | Total study population (n) | Percentage female | Age (years) | Preoperative average BMI (kg/m ²) | Previous bariatric surgery (n) | Compression garments (weeks) | Follow-up | Seroma assessment |
|---------------------------------------|--|---|----------------------|--|---|-------------------|------------------------------|---|-----------------------------------|------------------------------|-------------------|---|
| Costa-Ferreira et al ³⁴ | Prospective, single-center, controlled, nonblinded, nonrandomized trial (6 fully trained surgeons) | SF preservation (=infraumbilical, 2 closed-suction drains, carried out by 2 fully trained surgeons) (n = 65); control (=abdominoplasty, rectus abdominis muscle plication, no liposuction, no quilting sutures, 2 closed-suction drains, carried out by 4 fully trained surgeons) (n = 143) | Standard scalpel | 1250 (190-3050) 1153 (250-6000) | 208 | 100% 100% | 38 (22-54) 41 (24-65) | 26.63 (19.7-43.0) 27.89 (19.1-39.3) | 6 (9%) 11 (8%) | 6 | NA | NA |
| Di Martino et al ³⁵ | Prospective, single-center, controlled, nonblinded, randomized trial (1 surgeon) | SF preservation (=infraumbilical, liposuction limited to supraumbilical and flank regions, 2 closed-suction drains) (n = 20); control (=abdominoplasty, rectus abdominis muscle plication, no liposuction, no quilting sutures, 2 closed-suction drains) (n = 21) | Electrocautery | 1327 mL (600-2700) lipoaspirate 626.2 (330-1035) | 41 | 100% | 34.9 (26-53) 34.8 (26-50) | 25.1 (21.3-29.6) 23.7 (20-28) | 0 0 | 4 | 18-21 days | Clinical examination and US by the same investigator at 11-14 days and 18-21 days postoperatively |
| Koller and Hintringer ³⁶ | Prospective, single-center, controlled, nonblinded, randomized trial (4 fully trained surgeons) | SF preservation (=infraumbilical, 2 closed-suction drains) (n = 25); control (=abdominoplasty, rectus abdominis muscle plication, no liposuction, no quilting sutures, 2 closed-suction drains) (n = 25) | Ultrasonic scalpel | 968 1378 | 50 | NA | 37 39 | 25.40 27.10 | NA NA | Yes, unclear how long | 6 months (n = 36) | Clinical examination at the first follow-up; 18 patients had US followed by aspiration if necessary |
| Costa-Ferreira et al ³⁷ | Prospective, single-center, controlled, nonblinded, randomized trial (4 fully trained surgeons) | SF preservation (=infraumbilical, 2 closed-suction drains) (n = 80); control (=abdominoplasty, rectus abdominis muscle plication, liposuction limited to the flanks, no quilting sutures, 2 closed-suction drains) (n = 80) | Standard scalpel | 1025 (330-2800) 1087 (330-2700) | 160 | 100% 100% | 41 (21-68) 39 (23-61) | 26.3 (19.5-33.7) 25.4 (19.1-33.7) | 9 (11.3%) 12 (15%) | 6 | 6 months | Drain removal following at least 1 aspiration of nonhematic clear fluid; clinical examination |
| Correia-Gonçalves et al ³⁸ | Retrospective, single-center, controlled, nonblinded, nonrandomized (4 fully trained surgeons) | SF preservation (=infraumbilical, 2 closed-suction drains) (n = 30); control (=abdominoplasty, rectus abdominis muscle plication, liposuction limited to the flanks, no quilting sutures, 2 closed-suction drains) (n = 21) | NA | 1193.6 (585-3470) 1355.5 (480-2300) | 51 | 100% 100% | 38 (25-55) 39 (23-57) | 27.8 (22.4-41.1) 28.6 (22.3-35.3) | 30 (100%) 21 (100%) | 6 | 6 months | Drain removal following at least 1 aspiration of nonhematic clear fluid; clinical examination |
| Eiltantawy et al ³⁹ | Prospective, single-center, controlled, single-blinded, randomized trial (general) | SF preservation (=laterally, 2 closed-suction drains) (n = 25); control (=abdominoplasty, | Electrocautery | NA NA | 50, ventral hernia and abdominal wall deformity in all patients | 100% 96% | 45 43 | 36.4 36.7 | 5 (10%), unclear from which group | NA | 12 months | Clinical examination followed by US for clinically suspected seromas |

Table 2. Continued

| Reference | Study type | Intervention | Method of dissection | Tissue resection mass (g) | Total study population (n) | Percentage female | Age (years) | Preoperative average BMI (kg/m ²) | Previous bariatric surgery (n) | Compression garments (weeks) | Follow-up | Seroma assessment |
|-------------------------------|---|---|----------------------|--|----------------------------|-------------------|---------------------------|---|--------------------------------|------------------------------|------------|---|
| | surgeons and 1 of the study authors with previous training and experience in plastic surgery) | rectus abdominis muscle plication, correction of herniation with mesh, no liposuction, no quilting sutures, 2 closed-suction drains) (n = 25) | | | | | | | | | | |
| Inforzato et al ⁴⁰ | Retrospective, single-center, controlled, single-blinded, nonrandomized (1 fully trained surgeon) | SF preservation (infraumbilical, 1 closed-suction drain) (n = 21); control (=fleur-de-lis abdominoplasty, rectus abdominis muscle plication, no liposuction, 1 closed-suction drain) (n = 21) | Standard scalpel | 2236.4 (1010-5560) 1710.5 (660-3200) | 42 | 100% 100% | 39 (26-55) 37 (25-55) | 28 (22.4-41.1) 28.6 (22.3-35.3) | 21 (100%) 21 (100%) | NA | 6 months | Clinical examination at first follow-up; US 20 days posttreatment |
| Wolf et al ⁴¹ | Retrospective, single-center, controlled, nonblinded, nonrandomized (1 fully trained surgeon) | SF preservation (including elevation and tightening, supraumbilical and infraumbilical progressive tension sutures, 2 closed-suction drains in 51% of patients) (n = 179); control (=abdominoplasty, rectus abdominis muscle plication, liposuction limited to lateral epigastric areas and flanks, supraumbilical quilting sutures, 2 closed-suction drains in 66% of patients) (n = 65) | NA | 810.5 (450-1256) + 1151.5 mL lipoaspirate 630 (382-1310) + 1096.9 mL lipoaspirate | 244 | 98% 97% | 43.4 ± 9.01 42.8 ± 9.5 | 26.2 26.2 | 20 (11%) 9 (14%) | Yes, unclear how long | 2.7 months | Clinical examination |

BMI, body mass index; NA, not applicable; SF, Scarpa's fascia; US, ultrasound.

Primary Outcomes: Seroma (1) and Total Drain Output (2)

- (1) In 7 studies, postoperative seroma was investigated, which was assessed on clinical examination at the first follow-up, with or without an ultrasound, followed by aspiration if necessary.³⁵⁻⁴¹ In 3 studies determination of seroma was done by ultrasound.^{35,36,39,40} In 3 studies there was a significant decrease ($P < .05$) in the number of patients with postoperative seroma between the 2 groups, favoring the Scarpa's fascia preservation group.³⁵⁻³⁷ Overall, from the 380 patients that received an abdominoplasty including Scarpa's fascia preservation, 5.3% developed seroma. In contrast, of the 258 patients in the control group 15.1% developed seroma. Seroma incidence was significantly lower in the Scarpa's fascia preservation group than in the control group (Table 3).
- (2) The total drain output was measured in 6 studies. All studies showed a significant lower total drain output

($P < .05$) in the Scarpa's fascia preservation group when compared with the control group.^{34,36-40} Overall, of the 246 patients that received an abdominoplasty including Scarpa's fascia preservation the mean total drain output was 256 mL. In contrast, of the 315 patients in the control group the mean total drain output was 625 mL. Overall the total drain output in the control group was more than double that of the Scarpa's fascia preservation group (Table 4).

Secondary Outcomes: Hematoma (3), Time to Drain Removal (4), Length of Hospital Stay (5), Wound Dehiscence (6), and Infection Rate (7)

- (3) In 5 studies, postoperative hematoma was investigated, which was assessed on clinical examination.³⁷⁻⁴¹ No studies showed a significant difference between the patients that received an abdominoplasty including

Table 3. Postoperative Seroma in Patients After Scarpa's Fascia Preservation Abdominoplasty and Control Abdominoplasty

| Reference | SF preservation abdominoplasty | | | Control abdominoplasty | | | P value |
|---------------------------------------|--------------------------------|------------|---------------------------|------------------------|------------|---------------------------|---------|
| | Seroma (n) | Proportion | Total no. of patients (n) | Seroma (n) | Proportion | Total no. of patients (n) | |
| Costa-Ferreira et al ^{34,a} | NA | — | 65 | NA | — | 143 | — |
| Di Martino et al ³⁵ | 2 | 0.100 | 20 | 8 | 0.381 | 21 | .037 |
| Koller and Hintringer ³⁶ | 0 | 0 | 25 | 4 | 0.160 | 25 | .037 |
| Costa-Ferreira et al ³⁷ | 2 | 0.025 | 80 | 15 | 0.188 | 80 | .001 |
| Correia-Gonçalves et al ³⁸ | 2 | 0.066 | 30 | 4 | 0.191 | 21 | .177 |
| Eltantawy et al ³⁹ | 2 | 0.080 | 25 | 4 | 0.160 | 25 | .038 |
| Inforzato et al ⁴⁰ | 3 | 0.142 | 21 | 3 | 0.142 | 21 | 1 |
| Wolf et al ⁴¹ | 9 | 0.050 | 179 | 1 | 0.015 | 65 | .222 |
| Total incidence | 20 | 0.053 | 380 | 39 | 0.151 | 258 | <.00001 |

NA, not applicable; SF, Scarpa's fascia. ^aExcluded from the calculations.

Scarpa's fascia preservation and the control group. Overall, hematoma was observed in 1.5% of the Scarpa's fascia preservation group and in 2.8% of the control group (Supplemental Table 3).

- (4) In 6 studies, the time to drain removal was measured.^{34,36–40} Five studies showed a significant faster time to drain removal ($P < .05$) in the Scarpa's fascia preservation group when compared with the control group.^{34,37–40} In 1 study drain removal was performed after 3 days regardless of which treatment the patient received and the drain production.³⁶ Overall, of the 246 patients that received an abdominoplasty including Scarpa's fascia preservation the mean time to drain removal was 4 days. In contrast, of the 315 patients in the control group the mean time to drain removal was 7 days (Supplemental Table 4).
- (5) Six studies mentioned the length of hospital stay.^{34–40} Three studies showed a significant shorter time of hospital stay ($P < .05$) in the Scarpa's fascia preservation group when compared with the control group.^{34,37,38} Notably, 1 study showed a significant shorter hospital stay of the control group than the Scarpa's fascia preservation group.³⁷ In 2 studies there was a requisite hospital stay of 7 days regardless of which treatment the patient received, and in 1 study there was a hospital stay of 1 day for all patients.^{35,36,40} Overall, the mean length of hospital stay was 5.5 days in the Scarpa's fascia preservation group compared with 5.8 days in the control group (Supplemental Table 5).
- (6) In 6 studies, postoperative wound dehiscences were investigated; in all studies wound dehiscences were superficial.^{36–41} No studies showed a significant difference between the patients that received an

abdominoplasty including Scarpa's fascia preservation and the control group. Overall, a wound dehiscence was observed in 11.4% of the Scarpa's fascia preservation group and in 11.0% of the control group (Supplemental Table 6).

- (7) In 5 studies, postoperative infections were investigated.^{37–41} No studies showed a significant difference between the patients that received an abdominoplasty including Scarpa's fascia preservation and the control group. Overall, infections were observed in 2.1% of the Scarpa's fascia preservation group and in 5.2% of the control group. Even though none of the studies showed a significant difference, the difference between the total means was significant, favoring the Scarpa's fascia preservation group with fewer infections (Supplemental Table 7).

Disclosure Agreements

None of the studies received financial support, and there were no conflicts of interest (Supplemental Table 8).

Quality Control of the Included Studies

Five studies were level of evidence 2 studies, and 3 studies were level of evidence 3 studies (Table 5).^{34–41}

DISCUSSION

This systematic review demonstrates that the preservation of Scarpa's fascia during an abdominoplasty procedure is associated with a significant reduction in seroma formation,

Table 4. Postoperative Total Drain Output (mL) in Patients After Scarpa's Fascia Preservation Abdominoplasty and Control Abdominoplasty

| Reference | SF preservation abdominoplasty | | Control abdominoplasty | | P value |
|---------------------------------------|--------------------------------|---------------------------|------------------------------|---------------------------|---------|
| | Mean total drain output (SD) | Total no. of patients (n) | Mean total drain output (SD) | Total no. of patients (n) | |
| Costa-Ferreira et al ³⁴ | 214.85 (201.75) | 65 | 523.11 (521.61) | 143 | <.001 |
| Di Martino et al ^{35 a} | NA | 20 | NA | 21 | — |
| Koller and Hintringer ³⁶ | 93 (NA) | 25 | 157 (NA) | 25 | <.05 |
| Costa-Ferreira et al ³⁷ | 210 (460.21) | 80 | 609 (152.80) | 80 | <.0001 |
| Correia-Gonçalves et al ³⁸ | 250.7 (219.8) | 30 | 1181.9 (1177.2) | 21 | <.001 |
| Eltantawy et al ³⁹ | 686 (183.5) | 25 | 1410.8 (371.6) | 25 | <.0001 |
| Inforzato et al ⁴⁰ | 243.7 (96.9) | 21 | 445.4 (226.3) | 21 | <.001 |
| Wolf et al ^{41 a} | NA | 179 | NA | 65 | — |
| Weighted mean (total) | 255.61 | (246) | 625.06 | (315) | NA |

NA, not applicable; SD, standard deviation; SF, Scarpa's fascia. ^aExcluded from the calculations.

with an overall incidence rate of 5.3% compared with 15.1% after a traditional abdominoplasty. This is consistent with a previous review of 1824 abdominoplasties that showed seroma rates after a traditional abdominoplasty ranging from 1% to 57% with an average of 10%.⁴² Additionally, the total drain output after Scarpa's fascia preservation abdominoplasty is significantly lower, with a mean volume of 256 mL compared with a mean volume of 625 mL after a traditional abdominoplasty. This is in line with another review of 191 abdominoplasties, which found that total drain output ranged from 210 to 686 mL after Scarpa's fascia preservation abdominoplasty and 445 to 1410 mL after traditional abdominoplasty.⁴³ The time to drain removal in case of a Scarpa's fascia preservation abdominoplasty was approximately 4 days, in contrast to 7 days after a traditional abdominoplasty. The incidence of infections was also significantly lower when Scarpa's fascia was preserved during an abdominoplasty (2.1% compared with 5.2% after a traditional abdominoplasty). However, preserving Scarpa's fascia during an abdominoplasty did not affect the incidence of hematoma or wound dehiscence, nor did it affect the length of hospital stay. Based on these findings, the preservation of Scarpa's fascia during an abdominoplasty procedure is recommended. The senior author (BL) has employed this technique in over 400 cases, and none of his patients has experienced seroma.

In addition to sparing Scarpa's fascia during an abdominoplasty, various surgical strategies have been employed to reduce the risk of developing complications. With regard to seroma reduction, different dissection techniques (electrocautery dissection, scalpel dissection, and plasma-

kinetic energy-based dissection), lipoabdominoplasty procedures, the use of quilting sutures or PTS, placement of closed-suction drains, and the application of adhesives or fibrin glue have been employed.^{11–28} Because seroma formation after an abdominoplasty procedure is possibly correlated with the disruption of the lymphatic channels and definitely associated with the formation of a dead space and the shearing between the abdominal flap and the fascia, techniques that target 1 or more of these obstacles are presumably the most successful.^{8,15}

According to a study by Wijaya et al, the incidence of seroma formation appears to be lower when scalpel dissection is utilized during an abdominoplasty procedure, with or without Scarpa's fascia preservation, compared with electrocautery.⁴³ This is thought to be due to the potential for thermal damage to adjacent structures, such as small blood vessels and lymphatics, which could impede lymphatic drainage and lead to the formation of seroma.⁴³ However, because the larger lymphatics are located near the fascial planes rather than in the adipose tissue itself, the impact of thermal damage of the superficial small lymphatics on seroma formation after abdominoplasty procedures remains uncertain.²⁹ Possibly, when focusing on the thermal damage of the small blood vessels of the abdominal flap, the usage of scalpel dissection during an abdominoplasty lowers the risk of wound dehiscence or necrosis, however concrete evidence to support this claim is lacking in the literature.⁴⁴ A downside of scalpel dissection is that it may carry a higher risk of hematoma formation. Further research is necessary to fully understand the impact of various dissection techniques on seroma formation

Table 5. Quality Assessment of the Included Studies According to the Oxford Centre for Evidence-Based Medicine Criteria

| Reference | Level of Evidence |
|---------------------------------------|-------------------|
| Costa-Ferreira et al ³⁴ | 2 |
| Di Martino et al ³⁵ | 2 |
| Koller and Hintringer ³⁶ | 2 |
| Costa-Ferreira et al ³⁷ | 2 |
| Correia-Gonçalves et al ³⁸ | 3 |
| Eltantawy et al ³⁹ | 2 |
| Inforzato et al ⁴⁰ | 3 |
| Wolf et al ⁴¹ | 3 |

and wound healing in abdominoplasty procedures. It may be hypothesized that the larger wound margins in fleur-de-lis abdominoplasty increase the risk of seroma formation, however there is only 1 study included in this review that investigated the possible correlation of preserving Scarpa's fascia and seroma formation in patients who underwent fleur-de-lis abdominoplasty.⁴⁰ Study findings were that the incidence of seroma formation was equal in the Scarpa's fascia preservation group and the control group (14.2%). However, the total drain output was significantly higher in the control group. Nevertheless, as only 1 of the studies employed fleur-de-lis abdominoplasty, a definite conclusion cannot be drawn; more research is needed to confirm this potential benefit.

A common technique to reduce the dead space and shearing forces between the abdominal flap and the fascia is the use of quilting sutures or PTS placed at periodic intervals between the abdominal flap and the fascia. In 2020, Li and Wang found that PTS in lipoabdominoplasty procedures significantly reduced seroma rates when considering 5 controlled studies involving a total of 1255 patients.⁴⁵ Additionally, employment of PTS in lipoabdominoplasty procedures showed no difference in seroma rates related to utilization of closed-suction drains.⁴⁵ In abdominoplasty procedures without liposuction, Khan et al found that seroma formation and the time to drain removal was reduced with PTS, compared with a traditional abdominoplasty procedure.¹⁹ However, this study had a small sample size ($n < 100$) and the findings were not significant.¹⁹ Furthermore, the PTS group was retrospectively compared with a historical group that underwent a classical abdominoplasty and therefore it was not possible to eliminate all bias.¹⁹ Nahas et al also showed low seroma rates when utilizing PTS in an abdominoplasty procedure, but the study did not include a control group and had a small sample size ($n = 21$).⁴⁶ In 1 of the studies considered here, the seroma rates of a combined

procedure of Scarpa's fascia preservation with PTS during an abdominoplasty and a control group that underwent an abdominoplasty procedure without Scarpa's fascia preservation but with PTS were compared. Both groups demonstrated low seroma rates (5% in the Scarpa's fascia preservation group and 1.5% in the control group), without significant intergroup differences.⁴¹ This suggests that placing PTS could lower seroma rates regardless of Scarpa's fascia preservation during an abdominoplasty procedure. Although PTS in abdominoplasty procedures may reduce the incidence of seroma formation, it also carries certain drawbacks, such as longer surgery time, potential tissue dimpling, and increased risk of abdominal cutaneous nerve entrapment syndrome (ACNES), bleeding, or postoperative hematoma. Future studies should be done to investigate both short-term complications, such as seroma and hematoma, and long-term complications, such as ACNES, in relation to quilting sutures in abdominoplasty procedures.

Regarding the application of tissue adhesives or fibrin glue, a meta-analysis by Nasr et al has found that adhesives in abdominoplasty procedures does not result in a lower incidence of seroma formation.⁴⁷ This is in contrast to the findings of Seretis et al, which suggested that tissue adhesives in conjunction with Scarpa's fascia preservation and possibly PTS might independently reduce seroma rates.¹¹ It was theorized that tissue adhesives might act as hemostatic agents, sealing blood and lymphatic vessels, thus decreasing fluid accumulation and dead space that could lead to seroma formation.^{48–51} However, more clinical evidence is needed to confirm this potential benefit.^{50,52–55}

In recent years, an increasing number of surgeons have started performing abdominoplasty procedures without drains, because the preventive effect of drains on seroma formation has been called into question. Pisco et al demonstrated that applying 3 closed-suction drains does not confer any benefit in reducing the risk of seroma formation compared with the traditional 2 closed-suction drains in abdominoplasty.⁵⁶ Unfortunately, the study did not include an abdominoplasty group that did not involve any drains. In a 10-year, multicenter retrospective study, Rosen et al found that PTS in an abdominoplasty without drains reduced seroma incidence rates compared with techniques that used drains.⁵⁷ Additionally, in a 3-year, single-center retrospective study, Vernier-Mosca et al found no significant differences in complication rates between patients who underwent an abdominoplasty with PTS and drains and patients that underwent the same operation but without drains.⁵⁸ The group with drains had more seroma punctures and a higher amount of punctured fluid when compared with the group without drains.⁵⁸ It seems plausible that application of closed-suction drains following abdominoplasty may confer little benefit in lowering the risk of seroma formation. The senior author (BL), in the time since he started performing Scarpa's fascia-sparing

abdominoplasties and inserting drains for a maximum of 24 hours, with patients discharged the next day without drains in the absence of serious complications, has never observed seroma, in the course of more than 400 cases.

It is important to note that nonsurgical strategies, such as postoperative garments (eg, abdominal binders) and physical activity restrictions, may also play a role in reducing the risk of seroma formation following an abdominoplasty procedure. However, the related impact of these nonsurgical strategies, compared with surgical strategies such as Scarpa's fascia preservation or PTS, could not be determined from this review. This is because 6 of the 8 studies included in this review mentioned employing postoperative garments for 4-6 weeks postoperatively, whereas the other 2 studies did not mention any adoption of garments postoperatively.³⁴⁻⁴¹ Although it is not demonstrated by this review, in the personal experience of the senior author (BL), postoperative garments and physical activity restrictions can also help to lower the risk of seroma formation. It would be interesting to investigate the relative impact of these nonsurgical strategies on seroma formation after an abdominoplasty procedure in future research.

Finally, it is worth noting that in 1 of the studies in this review the clinical outcomes of Scarpa's fascia preservation during an abdominoplasty in patients with an average BMI of 36.6 were investigated.³⁹ This is in contrast to the other included studies, which had patients who had an average BMI below 30. It was found that both the total drain output and the time to drain removal were notably increased in the high BMI patients when compared with the other studies.³⁹ However, it should be noted that this particular study also included the correction of abdominal herniations with mesh, in contrast to the other studies included in this review. Therefore, it is difficult to determine with certainty the actual impact of a higher BMI on seroma formation from this study.

Limitations

This systematic review has some limitations that should be considered. One limitation is that it focused on the preservation of Scarpa's fascia during an abdominoplasty vs a control group that underwent traditional abdominoplasty. Therefore, no conclusions regarding the impact of other surgical or nonsurgical techniques on seroma formation after an abdominoplasty could be drawn. Additionally, 6 of the 8 included studies in this review contained bariatric patients, which could influence the results. Furthermore, only 3 studies included in this review had a large sample size ($n > 100$); the total number of patients included in this review was limited ($n = 846$) and predominantly female. More data, including data from male patients, would be useful in determining whether gender affects outcomes. Additionally, the review provided no information on patient satisfaction or

time to return to work, important factors that have an impact on patient quality of life.⁵⁹

CONCLUSIONS

The results of this systematic review indicate that the preservation of Scarpa's fascia during an abdominoplasty procedure is associated with a lower incidence of seroma, reduced total drain output, and faster drain removal, compared with the traditional method of performing an abdominoplasty without Scarpa's fascia preservation. Sparing Scarpa's fascia may lead to a reduction in the formation of seroma after the procedure and for this reason it should be considered as a routine practice.

Supplemental Material

This article contains [supplemental material](#) located online at www.aestheticsurgeryjournal.com.

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