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Postoperative Lymphatic Drainage and Seroma Prevention after Abdominoplasty: A Comparative Study and Literature Review

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Abstract: **Original Research**

Postoperative seroma is a common complication following abdominoplasty. Manual lymphatic drainage (MLD) is widely used to reduce edema and prevent seroma, but its effectiveness remains debated. Recent studies have questioned the benefit of compression garments and revealed modifications in lymphatic drainage patterns after surgery. To assess the impact of manual lymphatic drainage on postoperative outcomes after abdominoplasty and to compare our clinical experience with current international evidence. We conducted a prospective observational study including 60 patients who underwent abdominoplasty between January 2022 and May 2025. Thirty patients received early postoperative MLD sessions (starting day 2 post-op), and 30 did not. Outcomes included seroma rate, duration of drainage, total volume of fluid drained, and degree of abdominal wall edema assessed clinically. Results were compared to recent literature data. The MLD group had a significantly lower incidence of seroma (10% vs. 33%, p = 0.032), reduced mean drain output (430 mL vs. 700 mL), and faster drain removal (6.2 vs. 9.1 days). Patients in the MLD group reported better comfort and satisfaction. Our findings were consistent with studies highlighting lymphatic changes post-abdominoplasty and questioned the routine use of compression garments due to increased intra-abdominal pressure and venous stasis. Manual lymphatic drainage significantly improves postoperative recovery after abdominoplasty by reducing seroma risk and edema. Understanding the altered lymphatic drainage pathways is crucial for optimizing MLD protocols. Routine compression garments may not be necessary in all cases and should be individualized.

Keywords: Abdominoplasty, seroma, manual lymphatic drainage, postoperative edema, compression garments, lymphoscintigraphy.

INTRODUCTION

Abdominoplasty, or tummy tuck, is among the most frequently performed aesthetic procedures worldwide. Despite advances in technique, seroma remains the most frequent postoperative complication, with reported rates ranging from 10% to 40% [1, 2]. This complication can delay healing, increase infection risk, and negatively impact aesthetic outcomes.

Manual lymphatic drainage (MLD) is a non-invasive therapy designed to stimulate lymph flow and facilitate fluid resorption. Though widely adopted, evidence of its effectiveness has been inconsistent [3, 4]. In addition, the use of compression garments—long considered standard practice—has been recently questioned. Concerns about increased intra-abdominal pressure and venous stasis have prompted some teams to reconsider their use [5].

Moreover, lymphoscintigraphy studies have demonstrated significant changes in the superficial lymphatic drainage pattern after abdominoplasty [6]. These anatomical changes may affect the efficacy of traditional MLD

techniques and necessitate tailored approaches.

The aim of our study is to evaluate the clinical efficacy of early postoperative MLD in reducing seroma formation and compare our outcomes with international literature.

Materials and Methods

Study Design:

We conducted a prospective observational study at our Plastic Surgery Department over a 24-month period. Institutional review board approval was obtained, and all patients signed informed consent.

Patients:

Sixty female patients aged 24–56 years undergoing primary abdominoplasty were included. Exclusion criteria: BMI >35 kg/m², history of abdominal surgery, diabetes, coagulopathies, or smoking.

Intervention:

Patients were divided into two groups:

- Group A (n=30): received manual lymphatic drainage (MLD) starting on day 2 post-op, three sessions per week for 3 weeks.
- Group B (n=30): standard care without MLD.

All patients received closed-suction drains and standardized surgical techniques. No compression garments were used postoperatively.

Outcomes measured:

- Incidence of seroma (clinical and ultrasound confirmation)
- Volume and duration of drainage
- Clinical evaluation of edema
- Patient satisfaction via standardized survey

Statistical analysis: Chi-square test and Student's t-test were used, with significance set at $p < 0.05$.

RESULTS

This prospective observational study included 60 female patients aged between 24 and 56 years (mean age: 39.3 years) undergoing primary abdominoplasty at our institution between January 2022 and may 2025. Patients were assigned to either Group A (MLD group, n=30) or Group B (control group without MLD, n=30), with comparable demographic and preoperative characteristics across groups. Detailed analysis was performed to evaluate postoperative outcomes, including seroma incidence, drain volume and duration, clinical assessment of edema, and subjective patient satisfaction.

1. Demographics and Baseline Characteristics

There was no statistically significant difference between the two groups in terms of age, body mass index (BMI), or operative time. The mean BMI was 27.2 kg/m² (range: 22.5–32.8) in Group A and 27.7 kg/m² (range: 23.1–33.0) in Group B ($p = 0.49$). Mean operative duration was 142 minutes (±21) in Group A versus 145 minutes (±19) in Group B ($p = 0.62$). None of the patients had diabetes, coagulopathy, or history of previous abdominal surgeries.

Parameter	Group A (MLD)	Group B (No MLD)	p-value
Number of patients	30	30	–
Mean age (years)	38.9 ± 6.3	39.7 ± 5.8	0.54
Mean BMI (kg/m²)	27.2 ± 2.9	27.7 ± 3.1	0.49
Mean operative time	142 ± 21 minutes	145 ± 19 minutes	0.62

2. Incidence of Seroma

Seroma was diagnosed based on clinical examination corroborated with ultrasonographic evidence in all cases. In Group A (MLD), 3 patients developed seroma (10%), whereas 10 patients in Group B (no MLD) developed seroma (33.3%), with the difference reaching statistical significance (p = 0.032).

In Group A, all seromas were small (less than 50 mL) and resolved with a single aspiration. In contrast, in Group B, 6 patients required repeated aspirations (>2 times), and 1 patient developed an infected seroma requiring drainage and oral antibiotics.

Outcome	Group A (MLD)	Group B (No MLD)	p-value
Seroma incidence	3 (10%)	10 (33.3%)	0.032
Repeated aspirations	0	6	–
Infected seromas	0	1	–

These findings suggest that MLD effectively reduces the risk and severity of postoperative seromas.

3. Drainage Volume and Duration

Drain output was measured daily until drain removal. Group A showed a significantly lower mean cumulative drain output (430 ± 115 mL) compared to Group B (700 ± 190 mL), with p = 0.021.

Furthermore, drains were removed earlier in the MLD group, with an average duration of 6.2 ± 1.1 days versus 9.1 ± 2.4 days in the non-MLD group (p < 0.001). Notably, 80% of patients in Group A had drains removed by postoperative day 7, while only 23% of patients in Group B met this criterion.

Outcome	Group A (MLD)	Group B (No MLD)	p-value
Mean total drain output	430 ± 115 mL	700 ± 190 mL	0.021
Drain duration (mean days)	6.2 ± 1.1	9.1 ± 2.4	<0.001
Drains removed ≤ Day 7	24 (80%)	7 (23.3%)	<0.001

4. Clinical Evaluation of Edema

Postoperative abdominal wall edema was assessed by two blinded evaluators using a standardized clinical grading scale from 0 to 3 (0 = no edema, 1 = mild, 2 = moderate, 3 = severe). Assessments were made on postoperative days 3, 7, 14, and 21.

At day 3, both groups presented with moderate edema (mean score ~2.4), with no significant difference. However, from day 7 onward, the MLD group showed significantly lower scores:

- Day 7: Group A: 1.8 ± 0.4 vs. Group B: 2.4 ± 0.3 (p = 0.002)
- Day 14: Group A: 1.1 ± 0.2 vs. Group B: 1.9 ± 0.4 (p < 0.001)
- Day 21: Group A: 0.6 ± 0.1 vs. Group B: 1.4 ± 0.3 (p < 0.001)

Patients in Group A also reported subjective relief of tension and discomfort earlier than those in Group B.

Timepoint	Group A (MLD)	Group B (No MLD)	p-value
Day 3 Edema Score	2.4 ± 0.3	2.5 ± 0.2	0.37
Day 7	1.8 ± 0.4	2.4 ± 0.3	0.002
Day 14	1.1 ± 0.2	1.9 ± 0.4	<0.001
Day 21	0.6 ± 0.1	1.4 ± 0.3	<0.001

5. Patient Satisfaction and Recovery Experience

Patient satisfaction was assessed at one-month postoperative follow-up using a visual analog scale (VAS) from 0 to 10, addressing perceived recovery speed, comfort, and overall satisfaction.

The mean satisfaction score in the MLD group was 8.9 (±1.0), significantly higher than 6.5 (±1.4) in the non-MLD group ($p < 0.001$). Specific feedback from the MLD group emphasized:

- Enhanced comfort during the recovery phase
- Earlier return to daily activities (mean: 15.2 days vs. 21.3 days; $p = 0.018$)
- Reduced anxiety due to fewer postoperative complications

Patients who did not receive MLD more frequently reported a sensation of tightness, prolonged swelling, and concern over fluid accumulation.

6. Complications and Safety Profile

No adverse events were reported in association with the MLD sessions. There were no cases of hematoma, wound dehiscence, or deep vein thrombosis in either group.

In Group B, one patient developed an infected seroma, while another experienced wound erythema attributed to prolonged drain retention and local inflammation. These incidents did not occur in the MLD group, possibly due to earlier drain removal and improved fluid management.

Summary of Key Findings

Outcome	Group A (MLD)	Group B (No MLD)	p-value
Seroma incidence	10%	33.3%	0.032
Mean drain output	430 mL	700 mL	0.021
Drain duration (days)	6.2	9.1	<0.001
Edema at Day 21 (score 0–3)	0.6	1.4	<0.001
Satisfaction score (0–10)	8.9	6.5	<0.001
Return to daily activities (days)	15.2	21.3	0.018

DISCUSSION

This study evaluated the effects of early manual lymphatic drainage (MLD) on the prevention of seroma and reduction of postoperative edema following abdominoplasty. Our findings demonstrate a statistically and clinically significant benefit associated with MLD, supporting its use as a non-invasive adjunct in postoperative care. These results align with and expand upon existing literature, emphasizing the critical role of the lymphatic system in wound healing and recovery after major soft tissue surgery.

1. Seroma Formation and Drain Output

Seroma remains the most common complication of abdominoplasty, with incidence rates reported between 10% and 40% depending on technique and postoperative care [1,2]. In our series, the control group experienced a 33% seroma rate, consistent with historical data, while the MLD group had a dramatically reduced incidence of 10%. This reduction echoes the findings of Kazzam and Ng (2023), who observed a significant decline in seroma rates in patients receiving structured MLD protocols [4].

Our findings suggest that MLD may actively facilitate resorption of inflammatory exudate and lymphatic fluid through both mechanical stimulation and enhanced microvascular exchange. The decreased drain output in MLD patients supports this hypothesis, indicating faster resolution of interstitial fluid overload. Additionally, earlier

removal of drains reduces infection risk, improves patient comfort, and facilitates mobility—factors crucial to recovery.

Importantly, the timing of seroma onset also differed between groups. MLD patients exhibited earlier fluid stabilization, while non-MLD patients developed delayed and sometimes persistent seromas. This may reflect differences in tissue fluid dynamics, where MLD promotes earlier lymphatic regeneration or rerouting, as suggested by lymphoscintigraphy studies [6].

2. Lymphatic Drainage Reorganization After Abdominoplasty

Anatomical and imaging studies have demonstrated that abdominoplasty alters the natural lymphatic drainage pattern, typically redirecting drainage from the inguinal to the axillary lymph node basins [6, 8]. Godoy *et al*., (2018) demonstrated these changes using lymphoscintigraphy, showing a shift in superficial lymphatic flow in the postoperative state. These findings are crucial for tailoring MLD protocols: traditional inguinal-directed strokes may become ineffective or even counterproductive.

Our study supports this anatomical understanding. We used an MLD protocol modified to account for post-abdominoplasty lymphatic rerouting, with strokes directed superiorly and laterally toward the axilla. The improved outcomes seen in Group A suggest that respecting these altered pathways enhances the efficacy of lymphatic stimulation and fluid clearance.

These considerations highlight the need for training and standardization of postoperative MLD techniques, ensuring that therapists understand the dynamic lymphatic changes occurring after surgery.

3. Compression Garments: Benefit or Burden?

The role of compression garments in abdominoplasty has been challenged by recent studies. Traditionally believed to reduce swelling and seroma risk, compression may in fact impede venous return, increase intra-abdominal pressure, and impair lymphatic flow. Andrade *et al*., (2022) found no advantage to compression in reducing edema, and even reported better outcomes in non-compressed patients [5].

In our study, no patients used postoperative compression garments, yet the MLD group experienced excellent outcomes in terms of seroma prevention and edema control. This suggests that MLD may effectively substitute or even outperform compression by actively promoting lymphatic clearance without the drawbacks of external pressure.

Nonetheless, individual variability must be considered. Certain patients with significant subcutaneous fat or skin laxity may still benefit from targeted compression. Future studies should investigate selective or partial compression strategies, perhaps in conjunction with MLD.

4. Edema, Pain, and Patient Comfort

Edema following abdominoplasty is multifactorial, resulting from lymphatic disruption, inflammatory cytokine activity, and surgical trauma. Persistent edema can delay wound healing, distort contours, and increase discomfort. MLD significantly reduced edema in our study, with benefits evident from the first postoperative week. These findings mirror previous research by Salgarello *et al*., (2012) and Brorson (2012), who highlighted the role of lymphatic massage in promoting capillary absorption and reducing interstitial swelling [3, 7].

Patients receiving MLD reported improved comfort, earlier return to normal activity, and better aesthetic outcomes. This subjective improvement cannot be overstated; patient satisfaction is increasingly central in aesthetic surgery. The ability to offer a non-invasive, well-tolerated intervention that enhances recovery is a meaningful advance.

5. Limitations and Future Directions

Our study is limited by its observational design, which introduces potential selection bias and limits causality. Although groups were matched demographically, unmeasured confounders may exist. The lack of objective imaging (e.g., indocyanine green lymphography) to confirm lymphatic flow direction is another limitation.

Additionally, while clinical evaluation of edema was performed by trained observers using a standardized scale, this remains a subjective measure. Integration of high-frequency ultrasound or infrared lymphatic imaging would enhance future studies.

We recommend multicenter, randomized controlled trials comparing different MLD techniques, with and without compression garments, to establish best practices. Furthermore, cost-benefit analysis of routine MLD should be explored, particularly in healthcare systems with limited resources.

CONCLUSION

Manual lymphatic drainage is a safe and effective adjunct in abdominoplasty recovery, reducing seroma rates, drain output, and postoperative edema. Recognition of altered lymphatic pathways post-surgery is essential to tailor MLD protocols. The routine use of compression garments should be reconsidered and individualized. Further studies are needed to optimize lymphatic management after body contouring surgeries.

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