Egypt, J. Plast. Reconstr. Surg., Vol. 49, No. 4, October: 285-291, 2025

Comparison between Vacuum Drain and Passive Drain in Abdominoplasty: Randomized Clinical Study

MOSTAFA MAMDOH HAREDY, M.D.*; POLA FAYEZ FANOS AGAIBY, M.B.B.Ch**;
NOHA OTHMAN ABDEL KAREEM, M.D.* and AHMED GABER AHMED ABD EL MEGGED, M.D.*

The Department of Plastic Surgery, Faculty of Medicine, Sohag University and Plastic Surgery Department, Sohag General Hospital***

Abstract

Background: Postoperative drainage is a commonly utilized technique that can be classified as either active or passive. In abdominoplasty procedures, suction drains are frequently employed to help prevent seroma formation.

Objective: This study aimed to compare subcutaneous fluid accumulation when using a vacuum drain versus a passive drain during abdominoplasty surgery.

Patients and Methods: This randomized clinical trial included 20 patients, both male and female, aged between 20 and 60 years. They presented varying degrees of excess abdominal skin and fat, along with different levels of abdominal muscle laxity. These conditions stemmed from changes in abdominal volume due to bariatric surgery, weight loss through diet, or multiple pregnancies. The participants were equally assigned to two groups: The Vacuum group, which received treatment with a vacuum drain, and the Passive group, which was managed using a passive drain.

Results: There were no significant distinctions between the two groups in terms of age, weight, height, body mass index, or existing health conditions. Both groups were composed exclusively of female patients. The amount of fluid collected in the drain and the timing of its removal remained consistent between the groups across days 1 through 5. Additionally, postoperative complications showed no significant variation between the two groups.

Conclusions: Both vacuum and passive drains are generally regarded as safe for use in abdominoplasty procedures. There were no notable differences between the two groups concerning age, weight, height, body mass index, or comorbidities. All patients in both groups were female. Moreover, the drain output volume and the timing of drain removal remained consistent between the groups across days 1 through 5.

Correspondence to: Dr. Pola Fayez Fanos Agaiby,
E-Mail: polafayezplastic@gmail.com

Key Words: *Vacuum Drain – Passive Drain – Subcutaneous Collection – Abdominoplasty.*

Ethical Committee: The study received approval from the Ethical Committee of Sohag Faculty of Medicine, University of Sohag, Egypt, and all participants provided written informed consent. IRB registration number: Soh-Med-23-12-10MS. Date 11-12-2023.

Disclosure: No disclosure.

Introduction

Obesity is a major public health crisis that has steadily intensified over the past five decades. After smoking, it ranks as the second leading cause of preventable death **[1]**. Losing 5% to 10% of body weight can greatly boost overall health, improve quality of life, and reduce financial strain for both individuals and the nation **[2]**.

An abdominoplasty, commonly known as a tummy tuck, is a surgical procedure designed to eliminate excess skin and fat from the abdomen while also tightening the abdominal muscles. This procedure is especially popular among individuals looking to remove extra abdominal tissue, particularly after substantial weight loss or as part of their weight loss journey **[3]**.

Seromas and hematomas are frequent complications after surgery, affecting as many as one-third of patients. If left untreated, they can result in infections, which may lead to flap deterioration caused by necrosis **[4]**.

The issue of subcutaneous collection is well recognized as a significant challenge in the field of abdominoplasty. Multiple hypotheses have been put up on the etiology of subcutaneous collection,

and several strategies have been offered to manage this problem [5]. The strategies involve a range of operational modifications, such as limiting undermining, performing minimal liposuction, and using quilting sutures and tissue glues. However, these methods have their own limitations, and none have been able to completely eliminate subcutaneous collection [6].

Postoperative drainage is a commonly employed method that can be classified into active or passive types. Active drainage systems utilize negative pressure to extract excess fluid from a wound, whereas passive systems rely on internal wound pressure, capillary action, and gravity to facilitate fluid removal. In essence, the fluid is expelled due to the pressure difference between the wound's interior and its external environment [7].

After abdominoplasty, suction drains are commonly employed as a precaution to prevent seroma formation. In a comprehensive study by Matarasso et al. [8], 98% of the surgeons surveyed indicated that they routinely use suction drains during their abdominoplasty procedures [9]. Suction drains remain widely used and should be considered whenever dead space is present. However, there has been a lack of sufficient research comparing the effectiveness of drain vacuum in abdominal surgeries [10].

The aim of this study was to compare subcutaneous fluid drainage in abdominoplasty surgery using Vacuum Drain and Passive Drain insertion techniques.

Patients and Methods

This randomized clinical trial involved 20 patients, aged 20 to 60 years, all were females, who exhibited varying degrees of excess abdominal skin and fat, as well as different levels of abdominal muscle laxity. These conditions resulted from changes in abdominal volume following bariatric surgery, weight loss through dieting, or multiple pregnancies. Conducted between February and October 2024, the study received approval from the Ethical Committee of Sohag Faculty of Medicine, University of Sohag, Egypt. All participants provided written informed consent. IRB registration number: Soh-Med-23-12-10MS. Date 11-12-2023.

Patients were excluded if they were not suitable candidates for abdominoplasty, had a BMI ≥30 kg/m^2, were taking antiplatelet medications, were deemed unfit for surgery, or had allergies to any anesthesia components. The eligible participants were then evenly divided into two groups: The Vacuum group, which utilized a vacuum drain, and the Passive group, which employed a passive drain.

Each patient received a thorough evaluation, including a review of their medical history, a physical examination, laboratory tests (such as liver and kidney function assessments and coagulation profiles), and imaging studies (including ultrasound and CT scans).

Drainage options post-abdominoplasty:

Vacuum drains are active drainage systems that generate negative pressure to help remove fluids from the surgical area. They were commonly employed in situations where there is an increased risk of seroma formation, such as with extensive tissue manipulation or the removal of large amounts of adipose tissue.

Passive drains used gravity to drain fluid without generating negative pressure. They were ideal for patients undergoing less invasive procedures or those with a lower risk of fluid buildup. Ensuring patient comfort was crucial, as these drains required more frequent monitoring.

Volumetric changes in the abdominal cavity:

Patients were educated about the anticipated alterations in abdominal shape after surgery, caused by swelling and fluid redistribution. Regular follow-up appointments helped track these changes, ensuring prompt action if any complications occurred. Recording preoperative measurements and comparing them with postoperative assessments offered important insights for assessing the results of the surgery.

Surgical procedure:

The surgery commenced with patient preparation and draping under general anesthesia. Each patient underwent a complete abdominoplasty, which included umbilical transposition, rectus abdominis plication, and the preservation of the Scarpa fascia along with the deep fat compartment in the infraumbilical region. Electrocautery was used to dissect the abdominal flap in two distinct planes: beneath the Scarpa fascia in the lower abdomen and pre-muscularly in the epigastric region and infraumbilical midline. Liposuction was limited to the flanks and upper abdomen, with no other procedures performed during the surgery. No quilting sutures were applied. In group A, two closed-suction drains were placed with active suction in the right and left iliac fossae (Redivac suction drain, size 16,

with a negative pressure of 500mmHg). In group B, the same type of drains were used for passive suction, employing a plastic catheter and urine collection bag. The procedure was identical for both groups. Compression garments were applied in the operating room, and patients were encouraged to begin walking on the first day after surgery. Drains were removed when the output from a single drain was 50ml or less within 24 hours, but not before the first 24 hours had passed. Patients wore compression garments for a minimum of six weeks and avoided strenuous activities. The study assessed the total and daily drain output, the time until drain removal, and the incidence of postoperative complications, including fluid collections, infections, and wound healing issues.

Statistical analysis:

Statistical analysis was performed using SPSS v26 (IBM Inc., Chicago, IL, USA). The normality of the data distribution was assessed with the Shapiro-Wilks test and histograms. For quantitative parametric variables, the mean and standard deviation (SD) were reported, and group comparisons were made using an unpaired Student's *t*-test. Qualitative variables were presented as frequencies and percentages, with analyses conducted using the Chi-square test or Fisher's exact test, as applicable. A two-tailed *p*-value less than 0.05 was considered statistically significant.

Results

A total of 27 patients were evaluated for eligibility. Four patients were excluded due to a BMI exceeding 35, and three patients declined participation due to concerns about potential complications. The remaining participants were randomly assigned to two equal groups, each consisting of 10 patients. All participants were monitored and analyzed statistically. Fig. (1).

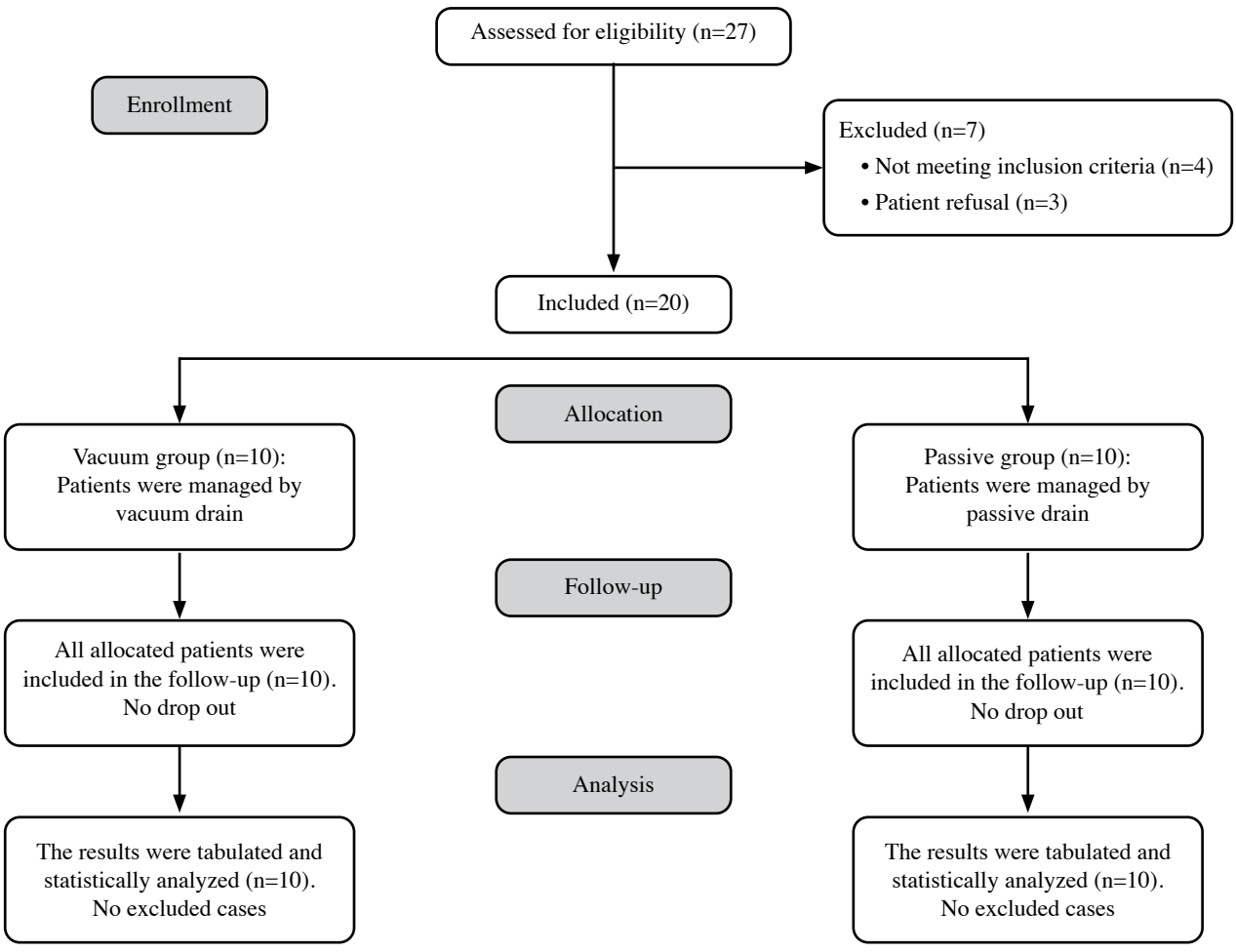

Fig. (1): CONSORT flow diagram of the participants through each stage of the trial.

There were no significant differences in age, weight, height, BMI, or comorbidities between the two groups. Both groups consisted entirely of female patients. Table (1).

The quantity of drain collected and the timing of drain removal showed no significant differences between the two groups on days 1,2,3,4, and 5. Table (2).

The time for drain removal was minimally different between the two groups. Table (3).

We followed-up the patients 3 weeks postoperatively to detect any complications and there was no significant difference in postoperative complications between the two groups. Table (4).

Table (1): Demographic data and comorbidities of the studied group.

	Vacuum group (n=10)	Passive group (n=10)	*p*
Age (years)	38.2±4.71	34.2±5.33	0.092
Sex:			
Female	10 (100%)	10 (100%)	1
Weight (kg)	86.3±4.08	88.1±4.15	0.341
Height (m)	1.6±0.03	1.62±0.04	0.335
BMI (kg/m^2)	33.69±0.66	33.77±0.6	0.794
Comorbidities:			
Hypertension	2 (20%)	0 (0%)	0.333
Diabetic	0 (0%)	1 (10%)	

Data are presented as mean ± SD or frequency (%).
BMI: Body mass index.

Table (2): Amount of drain collected and time of drain removal the studied groups.

	Vacuum group (n=10)	Passive group (n=10)	*p*
Amount of drain collected:			
Day 1	575±194.72	614±367.52	0.770
Day 2	326±146.83	333±227.65	0.936
Day 3	160±112.55	190±205.97	0.691
Day 4	73±49.23	106±92.52	0.333
Day 5	43.33±44.12	101.43±115.96	0.274
Day 6	50±0	250±0	–
Day 7	–	150±0	–
Day 8	–	60±0	–
Day 9	–	–	–

Data are presented as mean ± SD.

Table (3): Time of drain removal of the studied groups.

	Vacuum group (n=10)	Passive group (n=10)	*p*
Time of drain removal:			
Day 5	6 (60%)	3 (30%)	0.111
Day 6	2 (20%)	6 (60%)	
Day 7	2 (20%)	0 (0%)	
Day 9	0 (0%)	1 (10%)	

Data are presented as frequency (%).

Table (4): Postoperative complications of the studied groups.

	Vacuum group (n=10)	Passive group (n=10)	*p*
Hematoma	0 (0%)	1 (10%)	0.317
Wound infection	0 (0%)	1 (10%)	
Seroma collection	0 (0%)	1 (10%)	

Data are presented as frequency (%).

Group A: Passive Drains:

Case (1): A 25-year-old female patient with a BMI of 33.05 (90kg, 1.65m), not hypertensive or diabetic, underwent classic abdominoplasty for excess abdominal skin folds after weight loss. A passive drain was inserted and removed on day 6 postoperatively without complications. Fig. (2).

Group B: Active Drains:

Case (2): A 29-year-old female patient, non-hypertensive and non-diabetic, with a BMI of 33.07 (81kg, 1.55m) and excess abdominal skin folds after weight loss, underwent classic abdominoplasty. An active vacuum drain was inserted postoperatively and removed on day 5 without complications. Fig. (3).

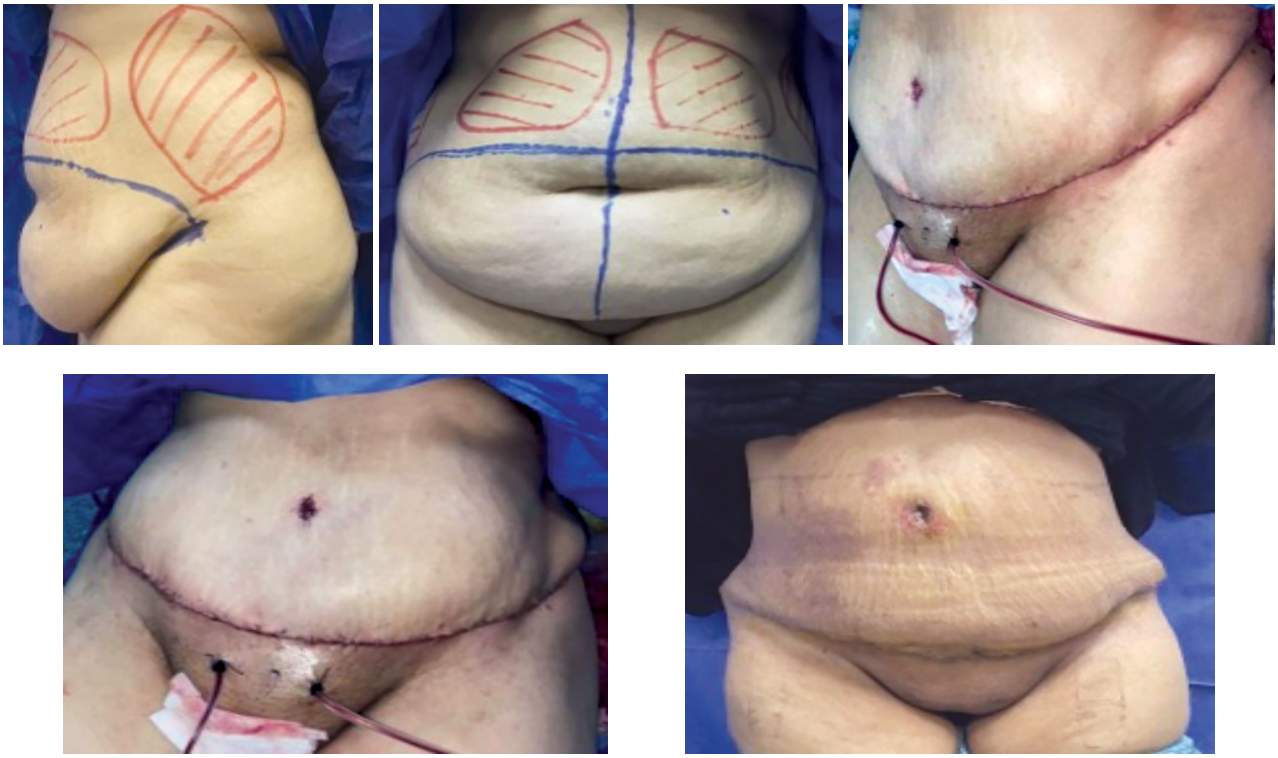

Fig. (2): Clinical picture of case No. (1).

Fig. (3): Clinical picture of case No. (2).

Discussion

Abdominoplasty, or a tummy tuck, is a surgical procedure designed to eliminate surplus skin and fat from the abdomen and tighten the muscles beneath [11].

The study's results indicate that from Days 1 to 5, there were no significant differences in drainage amounts between the two groups. However, a notable difference was observed on Day 6, where the vacuum drainage group collected an average of 50mL (±0), while the passive drainage group collected 250mL (±0). On Day 7, the passive group collected 150mL (±0), and on Day 8, it collected 60mL (±0). These findings suggest that the vacuum drainage group experienced significantly less drainage than the passive group starting on Day 6. This aligns with previous research by Taylor et al. [12], which reported better drainage control with vacuum systems, especially in minimizing postoperative fluid accumulation.

On Days 7 and 8, the passive drainage group exhibited a greater volume of drainage (150mL and 60mL, respectively), whereas the vacuum group showed significantly lower drainage. This difference in drainage volumes reinforces the hypothesis that active suction drainage is more effective at managing excess fluid than passive drainage, as suggested by Harris et al. [13].

Because of frequent complication, several studies aimed at reducing the incidence of seroma collection. The use of quilting sutures, as recommended by Baroudi and Ferreira [14,15], have been associated with the reduction of both the incidence and volume of seroma drained in abdominoplasty. Post bariatric patients have a high rate of complications, especially of seroma, after abdominoplasty. The use of a slow clotting fibrin glue seems to reduce the incidence of seroma collection and allows to not place drains. The absence of drainages reduces patients' hospitalization time and improves postoperative recovery [16].

The drain removal times in the groups studied did not differ significantly, with both groups showing similar durations, indicating that the type of drainage system did not substantially affect the removal time. However, Tsujita et al. [17] found that keeping the drain in for over 72 hours helped prevent wound infections, especially after breast surgery. On the other hand, Nakayama et al. [18] argued that drain removal was too premature to observe its clinical effects, noting that 41% of SSIs happened soon after removal. A recent systematic review and meta-analysis by Ishinuki et al. [19] found that subcutaneous drains following abdominal surgery helped reduce SSIs and shorten hospital stays, but did not have a significant impact on seroma formation. The study also called for more research into the optimal timing for drain removal. Liu et al. [20] had previously reported a high infection rate associated with drain placement.

In conclusion, the rates of postoperative complications like hematoma, wound infection, and seroma formation were similar between the groups. No significant differences in complication rates were observed, suggesting that the type of drainage did not influence the occurrence of these issues. Baier et al. [21] found that subcutaneous drains in the abdominal area did not offer any benefits or reduce the incidence of surgical site infections after laparotomy. Previous research has shown that seroma formation typically peaks around two weeks post-surgery, by which time most drains have been removed. Furthermore, Bonnema et al. [22] observed no differences in seroma formation following axillary dissection and drainage with high versus low vacuum after modified radical mastectomy. Lastly, while few studies have compared vacuum drains to passive drains in decompressive craniectomies, Sam et al. [23] concluded that vacuum drains, passive drains, and no drains can all be used safely in decompressive craniectomies without increasing complication rates. A greater amount of subgaleal hematoma was not associated with worse outcomes.

The study had several limitations. The small sample size made it difficult to detect differences in outcomes such as infection rates or fluid buildup. Variations in surgical techniques and a short follow-up period added complexity to comparing the two drainage methods, as long-term complications might have been overlooked. Additionally, inconsistencies in defining key outcomes across studies hindered the ability to make definitive conclusions. Ethical concerns were raised when randomizing patients to different drainage methods, particularly if existing evidence favors one approach. The hospital-based nature of the study and its small sample size limited its capacity to identify significant differences and reduced its generalizability. Furthermore, the study was not conducted across multiple centers, which could introduce publication bias and may not represent diverse patient populations. Selection bias was also a concern, as the participants may not reflect the broader abdominoplasty population, and the lack of blinding could have led to biased results due to awareness of the drainage method used.

Conclusions:

Both vacuum and passive drains are typically regarded as safe for use in abdominoplasty procedures. The likelihood of complications, such as seromas, hematomas, or infections, is similar for both types of drainage systems.

References

1- Baroudi R. and Ferreira C.A.: Seroma: How to avoid it and how to treat it. Aesthet Surg J., 18 (6): 439-41, 1998.

2- Baroudi R. and Ferreira CA. Contouring the hip and the abdomen. Clin. Plast. Surg., 23 (4): 551-72, 1996.

3- Pilone V., Vitiello A., Borriello C., Gargiulo S. and Forestieri P.: The use of a fibrin glue with a low concentration of thrombin decreases seroma formation in postbariatric patients undergoing circular abdominoplasty.

4- Kozlov A.I.: [Carbohydrate-related nutritional and genetic risks of obesity for indigenous northerners]. Vopr Pitan, 88: 5-16, 2019.

5- Gowd V., Xie L., Zheng X. and Chen W.: Dietary fibers as emerging nutritional factors against diabetes: Focus on the involvement of gut microbiota. Crit. Rev. Biotechnol., 39: 524-40, 2019.

6- Danilla S.: Rectus abdominis fat transfer (RAFT) in lipoabdominoplasty: A new technique to achieve fitness body contour in patients that require tummy tuck. Aesthetic Plast. Surg., 41: 1389-99, 2017.

7- Ho W., Jones C.D., Pitt E. and Hallam M.J.: Meta-analysis on the comparative efficacy of drains, progressive tension sutures and subscarpal fat preservation in reducing complications of abdominoplasty. J. Plast. Reconstr. Aesthet. Surg., 73: 828-40, 2020.

8- Awad S.S., Stern J.D., Milne C.T., Dowling S.G., Sotomayor R., Ayello E.A., et al.: Surgical reconstruction of stage 3 and 4 pressure injuries: A literature review and proposed algorithm from an interprofessional working group. Adv. Skin Wound Care, 36: 249-58, 2023.

9- Morozova A., Cotes C., Aran S. and Singh H.: Challenges in interpretation of US breast findings in the emergency setting. Radiographics, 43: 25-45, 2023.

10- Neaman K.C., Armstrong S.D., Baca M.E., Albert M., Vander Woude D.L. and Renucci J.D.: Outcomes of traditional cosmetic abdominoplasty in a community setting: A retrospective analysis of 1008 patients. Plast. Reconstr. Surg., 131: 403-10, 2013.

11- Matarasso A., Suri S. and Stein M.J.: Lipoabdominoplasty technique. PAR, 8: 17-25, 2021.

12- Neaman K.C., Armstrong S.D., Baca M.E., Albert M., Vander Woude D.L. and Renucci J.D.: Outcomes of traditional cosmetic abdominoplasty in a community setting: A retrospective analysis of 1008 patients. Plast. Reconstr. Surg., 131: 403e-10e, 2013.

13- Janis J.E., Khansa L. and Khansa I.: Strategies for postoperative seroma prevention: A systematic review. Plast. Reconstr. Surg., 138: 240-52, 2016.

14- Rassam M. and Davoudi B.: Abdominoplasty surgery. Eurasian J. Chem. Med. Pet., 30: 703-13, 2024.

15- Taylor M.E., Ngaage L.M., Wasicek P., Ha M., Nagarsheth K., Toursavadkohi S.A., et al.: Vacuum-Assisted Incisional Closure Therapy After Groin Reconstruction With Muscle Flap. Cureus, 13: 25-30, 2021.

16- Harris E., Yorke J., Law K., Winter-Roach M.B. and Taylor S.: Advanced ovarian cancer patients' experiences of surgical treatment: A qualitative analysis. Semin Oncol. Nurs., 40: 151-65, 2024.

17- Tsujita E., Yamashita Y., Takeishi K., Matsuyama A., Tsutsui S., Matsuda H., et al.: Subcuticular absorbable suture with subcutaneous drainage system prevents incisional SSI after hepatectomy for hepatocellular carcinoma. World J. Surg., 36: 1651-566, 2012.

18- Nakayama H., Takayama T., Okubo T., Higaki T., Midorikawa Y., Moriguchi M., et al.: Subcutaneous drainage to prevent wound infection in liver resection: A randomized controlled trial. J. Hepatobiliary Pancreat Sci., 21: 509-17, 2014.

19- Ishinuki T., Shinkawa H., Kouzu K., Shinji S., Goda E., Ohyanagi T., et al.: Recent evidence for subcutaneous drains to prevent surgical site infections after abdominal surgery: A systematic review and meta-analysis.World J. Gastrointest Surg., 150: 2879-89, 2023.

20- Liu C.L., Fan S.T., Lo C.M., Wong Y, Ng I.O., Lam C.M., et al.: Abdominal drainage after hepatic resection is contraindicated in patients with chronic liver diseases. Ann. Surg., 239: 194-201, 2004.

21- Baier P.K., Glück N.C., Baumgartner U., Adam U., Fischer A. and Hopt U.T.: Subcutaneous Redon drains do not reduce the incidence of surgical site infections after laparotomy. A randomized controlled trial on 200 patients. Int. J. Colorectal Dis., 25: 639-43, 2010.

22- Bonnema J., van Geel A.N., Ligtenstein D.A., Schmitz P.I. and Wiggers T.: A prospective randomized trial of high versus low vacuum drainage after axillary dissection for breast cancer. Am. J. Surg., 173: 76-9, 1997.

23- Sam J.E., Kandasamy R., Wong A.S.H., Ghani A.R.I., Ang S.Y., Idris Z., et al.: Vacuum drains versus passive drains versus no drains in decompressive craniectomies-a randomized controlled trial on subgaleal drain complication rates (VADER Trial). World Neurosurg., 156: 381-91, 2021.