

Safety of Lipoabdominoplasty Versus Abdominoplasty: A Systematic Review and Meta-analysis

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Abstract

Background Lipoabdominoplasty is a powerful operation to maintain a youthful physique for aging people, improve body contouring, and remove excess skin caused by massive weight loss. Nonetheless, it is controversial to combine abdominoplasty and liposuction because of the potential for vascular damage of the abdominal flap and increased complications. The purpose of this article was to determine the complication rates of lipoabdominoplasty compared with traditional abdominoplasty.

Methods PubMed, EMBASE, and Cochrane databases were searched through July of 2018. Study results were analyzed utilizing a fixed random effects model. The outcomes were expressed as relative risk (RR) and 95% confidence interval. Subgroup analyses were conducted based on complications.

Results Overall, 17 trials enrolling 14,061 adult patients were searched. Of these patients, 577 (4.1%) developed seroma; 113 (0.8%) experienced hematoma; 783 (5.6%) experienced wound infection, dehiscence, or fat necrosis; 35 (0.2%) developed deep venous thrombosis; and 110 (0.7%) experienced scar deformity. A forest plot revealed fewer complications in the lipoabdominoplasty group than in the traditional abdominoplasty group (RR = 0.85; 95%

CI 0.74–0.97; $p = 0.017$). Subgroup analysis showed that the lipoabdominoplasty group had a lower incidence of hematoma (RR = 0.56; 95% CI 0.36–0.86; $p = 0.009$) and seroma (RR = 0.69; 95% CI 0.57–0.85; $p = 0.000$).

Conclusions Lipoabdominoplasty is a valuable tool to perfect body shape. This meta-analysis showed no evidence that it was associated with higher rates of complications.

Level of Evidence III This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Lipoabdominoplasty · Complication · Abdominoplasty · Meta-analysis

Introduction

Lipoabdominoplasty is becoming a common procedure to solve the problems of abdominal skin laxity, wrinkles, and abdominal bulging. As a powerful operation, it is utilized to maintain a youthful physique for aging people, improve body contouring, and remove excess skin caused by massive weight loss, playing a significant role in improving patients' quality of life and confidence.

Lipoabdominoplasty is not simply a combination of abdominoplasty and liposuction, and it has undergone various evolutions over the years. In 1985, Hakme introduced a new method called the mini-abdominoplasty technique, which consisted of elliptical resection of the suprapubic skin, liposuction on the abdomen and flanks, and plication of the infraumbilical and supraumbilical muscles [26]. Since then, Matarasso [17] and Lockwood

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[13, 14] further refined abdominoplasty to reduce complications through a series of measures, including setting up safe areas for liposuction and reserving the Scarpa fascia to decrease the tension of the wound closure. In 2001, Saldanha [23] first used the term lipoabdominoplasty to standardize abdominoplasty with a selective undermining along the internal borders of the rectus muscles. In contrast to traditional abdominoplasty, lipoabdominoplasty preserves the abdominal blood supply and lymphatic vessels through a limited undermining on the abdominal flap, thus reducing the incidence of complications, such as seroma, skin necrosis, and hematomas.

Despite numerous studies discussing the utility of lipoabdominoplasty, combining abdominoplasty and liposuction is controversial because of the potential for vascular damage of the abdominal flap and increased complications. Therefore, we conducted this meta-analysis to ascertain whether the incidence of complications is increased compared to traditional abdominoplasty. The aim of this article was to state clinical evidence on the safety of lipoabdominoplasty [6].

Materials and Methods

Literature Search

The PubMed, EMBASE, and Cochrane databases were searched through July of 2018 in accordance with the preferred reporting items for systematic reviews and meta-analyses checklist [8]. The literature search was to investigate all available articles reporting complications associated with lipoabdominoplasty. Keywords used in this search were “lipoabdominoplasty,” “abdominoplasty,” and “liposuction” (AND or OR). The search was conditioned to human studies, and references from all eligible studies were methodically searched to identify any supplementary sources.

Study Selection

The inclusion criteria for the current meta-analysis included the following: (1) minimum follow-up of 3 months, (2) an article that provided sufficient raw data to evaluate the utility and safety of lipoabdominoplasty, (3) report of at least one complication (seroma, hematoma, deep venous thrombosis, wound infection, wound dehiscence, under correction, and/or fat necrosis), and (4) English language.

The exclusion criteria included the following: (1) no original data recorded or incomplete data, (2) review articles, (3) preclinical studies (animal studies or in vitro studies), (4) duplicate publications, (5) no complications reported, and (6) studies with ambiguous results.

Data Extraction

The remaining articles were screened by two independent investigators according to the prespecified selection criteria. Any divergence was settled by group discussion. Baseline data including author, year of publication, follow-up period, age, body mass index (BMI), and population size were collected using a standardized form. The primary outcome was the incidence of complications. Weighted proportions and 95% confidence intervals (CIs) of complications were calculated. In this meta-analysis, only observational studies were included due to the lack of randomized controlled studies. The analysis of pooled ratios was performed, and cases of incomplete information or missing were excluded.

Statistical Analysis

A meta-analysis of 17 studies was performed using a fixed effects model to pool the estimates and calculate confidence intervals (CIs) using STATA-15 statistical software (Stata corp., College Station, TX, USA). We evaluated the incidence of complications after lipoabdominoplasty. Dichotomous variables were analyzed with the Mantel–Haenszel method, and continuous variables were pooled by the inverse variance method. Results are expressed as relative risk (RR) and 95% confidence interval. Subgroup analysis was performed based on the types of complications. The I^2 statistic was performed to calculate the heterogeneity in studies. When I^2 is greater than 50%, the heterogeneity is significant, and the random effect model should be adopted. The fixed effect model is adopted when I^2 is less than 50%. A value of $p < 0.05$ in both models was considered statistically significant.

Results

Search Results

Figure 1 presents a flow diagram of the literature search and selection process. The database search yielded 483 citations from the PubMed, EMBASE, and Cochrane libraries, after which duplicates were excluded. The screening process of reviewing abstracts eliminated 263 articles, as they did not reach the inclusion criteria. In total, 220 studies were assessed for eligibility by reviewing the full text. The reasons for exclusion were the following: no original data/incomplete data ($n = 74$), review articles ($n = 25$), no human data ($n = 8$), or no complications reported ($n = 96$). The remaining 17 studies met all the inclusion criteria for the meta-analysis, consisting of seven cohort studies and ten retrospective case series.

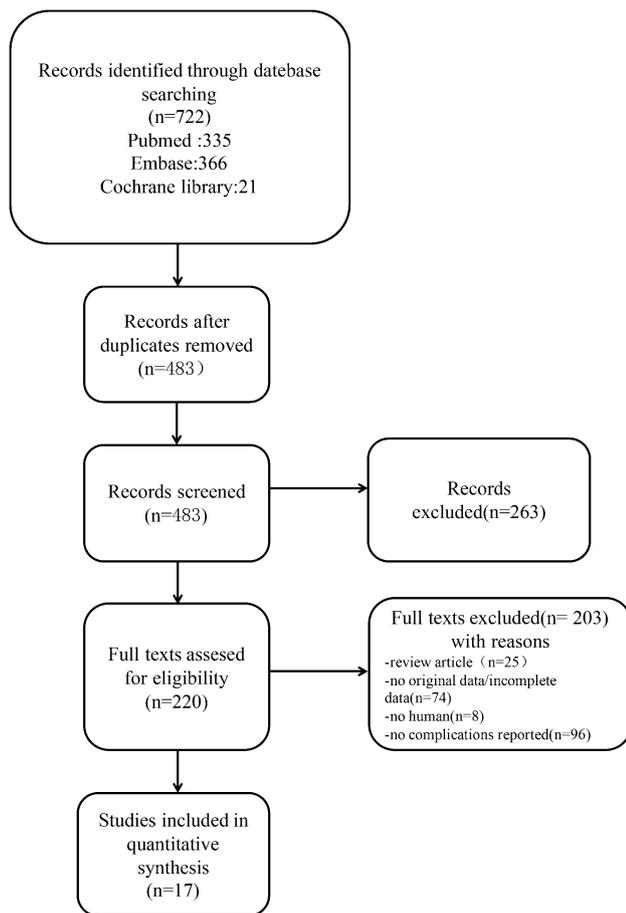


Fig. 1 Preferred reporting items for the reporting of systematic reviews and meta-analyses flow sheet

Baseline Characteristics

Table 1 summarizes the characteristics of the included studies. Overall, 14,061 adult patients were included in the 17 observational studies from 2006 to 2018, with an average age of 43.98 years and an average BMI of 26.97 kg/m². The mean follow-up time was 10.16 months across all studies. All studies identified the complication occurrence rate as the primary outcome indicator. Cohort studies were evaluated using the Newcastle–Ottawa Scale, with a range of 0–9 stars [16] (Table 2).

Complications

A combined 14,061 patients had complication results reported (Tables 3, 4). Of these patients, 577 (4.1%) developed seroma; 113 (0.8%) experienced hematoma; 783 (5.6%) experienced wound infection, dehiscence, or fat necrosis; 35 (0.2%) developed deep venous thrombosis; and 110 (0.7%) experienced scar deformity.

A forest plot was developed to analyze the safety of lipoabdominoplasty (Fig. 2). The statistical analysis results

indicated that there were fewer complications in the lipoabdominoplasty group than in the traditional abdominoplasty group (RR = 0.85; 95% CI 0.74–0.97; $p = 0.017$). There was no substantial heterogeneity as estimated using I^2 statistics ($I^2 = 0.0\%$; $p = 0.613$). A subgroup analysis of complications was performed, including seroma, hematoma, perfusion-related complications, deep venous thrombosis, and scar deformity. Six studies reported seroma rates in 12,532 patients. The combined rate of seroma demonstrated a significantly lower frequency in patients undergoing lipoabdominoplasty (RR = 0.69; 95% CI 0.57–0.85; $p = 0.000$). Heterogeneity was not apparent ($I^2 = 0.0\%$; $p = 0.922$). Five studies showed hematoma rates in 11,913 patients. The pooled results revealed that the hematoma rate was significantly reduced in the lipoabdominoplasty group (RR = 0.56; 95% CI 0.36–0.86; $p = 0.009$). Additionally, heterogeneity was not observed ($I^2 = 0.0\%$; $p = 0.947$). All these events were mild in severity, and there were no statistically significant differences between the lipoabdominoplasty group and the abdominoplasty group in perfusion-related complications (RR = 1.07; 95% CI 0.87–1.32; $p = 0.523$), deep venous thrombosis (RR = 1.56; 95% CI 0.42–5.79; $p = 0.505$), or scar deformity (RR = 1.08; 95% CI 0.55–2.10; $p = 0.827$).

Discussion

To the best of our knowledge, few meta-analyses have evaluated the complications of lipoabdominoplasty compared with traditional abdominoplasty. The combination of liposuction and abdominoplasty is controversial because of concerns about possible vascular damage of the abdominal flap and increased complications. Moreover, complications after lipoabdominoplasty are uncommon and transient in clinical practice. As a common operation in plastic surgery, it is necessary to systematically evaluate its safety.

The dead space and wound tension, which are created by the extensive undermining and advancement of the abdominal flaps, are the main cause of local complications in lipoabdominoplasty. Pollock et al. presented a relatively simple and practical technique—progressive tension sutures (PTS). As a reproducible adjunct to abdominoplasty, sutures are placed from the superficial fascia to the deep fascia. In the absence of a drain, the dead zone is tightly eliminated to prevent seroma and hematoma formation. In addition, PTS transfer tension to a strong superficial fascial system, and reduce the tension burden on the distal flap, which can significantly reduce the risk of hypertrophic scar formation and skin necrosis [19].

Seroma is the most common complication with an average incidence of 10% accepted by most plastic

Table 1 Characteristics of included studies

References	Location	Language	Type of study	Liposuction aspirate (ml)	Suction drainage (d)	BMI (kg/m ²)	N	Age (y)	FU (mo)	Tumescent infiltration (ml)
Hosseini et al. [7]	Iran	English	Retrospective review: case series	1700–3200 (2350)	NP	NP	25	33–62 (47)	4	NP
Vera Cuechiaro et al. [30]	Argentina	English	Retrospective review: case series	NP	0	19–29.8 (25.17)	276	19–67 (38)	24	NP
Kim et al. [12]	Korea	English	Retrospective review: case series	700–3100 (1384.86)	7	NP (21.50)	143	NP	12.1	NP (1646.91)
Smith and Smith [27]	USA	English	Retrospective review: case series	750–2200 (660)	NP	NP	300	NP	NP	NP
Epstein et al. [2]	USA	English	Retrospective review: case series	200–4300 (1315)	0	18.6–42.9 (25.1)	100	21–64 (40)	7	500–2000 (952)
Villegas [32]	Colombia	English	Retrospective review: case series	1000–8000 (4250)	NP	22–38.1 (30.1)	42	22–64 (47)	12.37	3000–8000 (NP)
Kanjoo and Singh [9]	India	English	Retrospective review: case series	350–2300 (NP)	3	NP	146	NP (43)	NP	NP (1030)
Weiler et al. [33]	USA	English	Retrospective review: case series	NP (3281.08)	7	NP (26)	173	NP (41.53)	12	NP (4073.03)
Gravante et al. [5]	Italy	English	Retrospective review: case series	305–2665 (866)	NP	24–35 (30)	103	40–60 (52)	NP	NP
Espinosa-de-los-Monteros et al. [3]	USA	English	Retrospective review: case series	500–6400 (2500)	NP	21–47 (31)	60	25–61 (43)	3	NP (3100)
Gould et al. [4]	USA	English	Retrospective cohort study	1592 ± 1048	0	NP (25.5)	619	NP (45)	7.25	NP
Vieira et al. [31]	USA	English	Retrospective cohort study	NP	NP	NP (27.93)	11,191	NP (43.58)	NP	NP
Roostaeian et al. [22]	USA	English	Retrospective cohort study	300–3350 (1028)	NP	21.9–31.3 (25.3)	18	32–60 (51)	3.23	423–2626 (1163)
Swanson [28]	USA	English	Retrospective cohort study	100–9850 (2206.68)	3	15.36–45.30 (26.91)	551	15.17–75.25 (41.29)	12.35	NP (1000)
Samra et al. [25]	USA	English	Retrospective cohort study	NP (2100.60)	NP	NP (28.95)	161	NP (39.7)	NP	NP (2335.71)
Rieger et al. [21]	Switzerland	English	Retrospective cohort study	NP (428)	NP	NP (27.2)	35	NP (45)	NP	NP
Kim and Stevenson [11]	USA	English	Retrospective cohort study	200–1425 (762.9)	8	19.6–38.4 (26.9)	118	NP (42.7)	14.5	NP

NP not reported, d days, BMI body mass index, y year, mo month

Table 2 Quality assessment of included studies

Cohort studies—Newcastle–Ottawa scale				
	Selection (max 4*)	Comparability (max 2*)	Outcome (max 3*)	Total (max 9*)
Vieira et al. [31]	☆☆	☆	☆	☆☆☆☆
Roostaiean et al. [22]	☆☆	☆	☆☆☆	☆☆☆☆☆☆
Swanson [28]	☆☆☆	☆	☆☆	☆☆☆☆☆☆
Samra et al. [25]	☆☆	☆	☆☆	☆☆☆☆☆☆
Rieger et al. [21]	☆☆	☆☆	☆☆	☆☆☆☆☆☆
Kim and Stevenson [11]	☆☆☆	☆☆	☆☆☆	☆☆☆☆☆☆☆☆

* indicates ☆

Table 3 Complications in case series studies

References	N	Seroma	Hematoma	Perfusion-related complications			Deep vein thrombosis	Scar deformity
				Wound infection	Wound dehiscence	Fat necrosis		
Hosseini et al. [7]	25	0	2	0	0	0	0	4
Vera Cucchiaro et al. [30]	276	5	0	0	4	0	3	13
Kim et al. [12]	143	9	0	1	1	0	0	9
Smith and Smith [27]	300	14	0	6	8	0	2	21
Epstein et al. [2]	100	5	2	3	1	0	0	0
Villegas et al. [32]	42	4	0	0	0	0	0	0
Kanjor and Singh [9]	146	6	0	0	0	6	1	0
Weiler et al. [33]	173	6	0	13	12	3	7	5
Gravante et al. [5]	103	4	0	8	0	0	3	0
Espinosa-de-los-Monteros et al. [3]	60	2	0	2	6	3	0	0
Total	624	55 (8.81%)	4 (0.64%)	33 (5.29%)	32 (5.13%)	12 (1.92%)	16 (2.56%)	52 (8.33%)

surgeons [29]. Multiple studies have shown that PTS can effectively reduce complications, such as seroma. In the retrospective cohort study conducted by Gould et al. [4], patients were divided into a classic drain-based abdominoplasty group ($n = 320$) and PTS abdominoplasty group ($n = 299$). Overall, the rate of seroma was 2.6% in the PTS group, which is significantly lower than the 8.5% in the drains group ($p = 0.005$). PTS were proven to have lower rates of seroma than drain-based abdominoplasty. Several key studies have demonstrated support for the PTS technique. Khan [10] reported a dramatic decrease in the rate of seroma, from 26 to 4%, with the use of PTS. Macias et al. [15] supported this downward trend and presented a reduction from 9 to 2% seroma.

In addition to PTS, many scholars have improved the technique of lipoabdominoplasty to reduce complications and improve the satisfaction of postoperative patients, gradually making it a mature technique. On the one hand, a major improvement is selective undermining [18, 24]. The

deep inferior epigastric artery is the main blood supply vessel of the lower abdominal wall. Many perforating arteries pass through the rectus abdominis sheath and gather around the umbilicus to form a complex network of blood vessels, most of which are the terminal branches of the inferior epigastric artery. These perforators are mainly located laterally and below the umbilicus, with an average distance of 4 cm (2.5–6 cm) from the umbilical. Lateral branches of the deep inferior epigastric artery and perforator vessel are more predominant than medial perforator. Additionally, the lateral division sends out more perforator branches than the medial division (74% from the lateral branch as compared with 26% from the medial branch). After liposuction, a thin layer of fat and its connective tissues, lymphatics, arteries, and veins were retained under the Scarpa fascia, and the tunnel is selectively undermined in the median line of the upper abdomen, between the medial edges of the rectus abdominal muscles, to avoid the lateral area with abundant vascularization [1].

Table 4 Complications in cohort studies

References	Seroma		Hematoma		Perfusion-related complications				Deep vein thrombosis		Scar deformity	
					Wound infection		Wound dehiscence		Fat necrosis			
	LG	AG	LG	AG	LG	AG	LG	AG	LG	AG	LG	AG
Gould et al. [4]	25/477	9/142	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
Vieira et al. [31]	351/9638	85/1553	81/9638	23/1553	176/9638	31/1553	386/9638	52/1553	25/9638	1/1553	17/9638	1/1553
Roostaieian et al. [22]	1/9	0	0	0	0	0	0	0	1/9	0	0	0
Swanson [28]	8/150	1/17	0	0	16/150	2/17	0	0	0	0	1/150	0
Samra et al. [25]	NP	NP	NP	NP	2/93	2/68	2/93	4/68	0	2/68	NP	NP
Rieger et al. [21]	1/13	3/22	0	1/22	1/13	1/22	0	0	0	0	0	2/13
Kim and Stevenson [11]	23/79	15/39	2/79	2/39	1/79	1/39	0	1/39	0	0	0	0

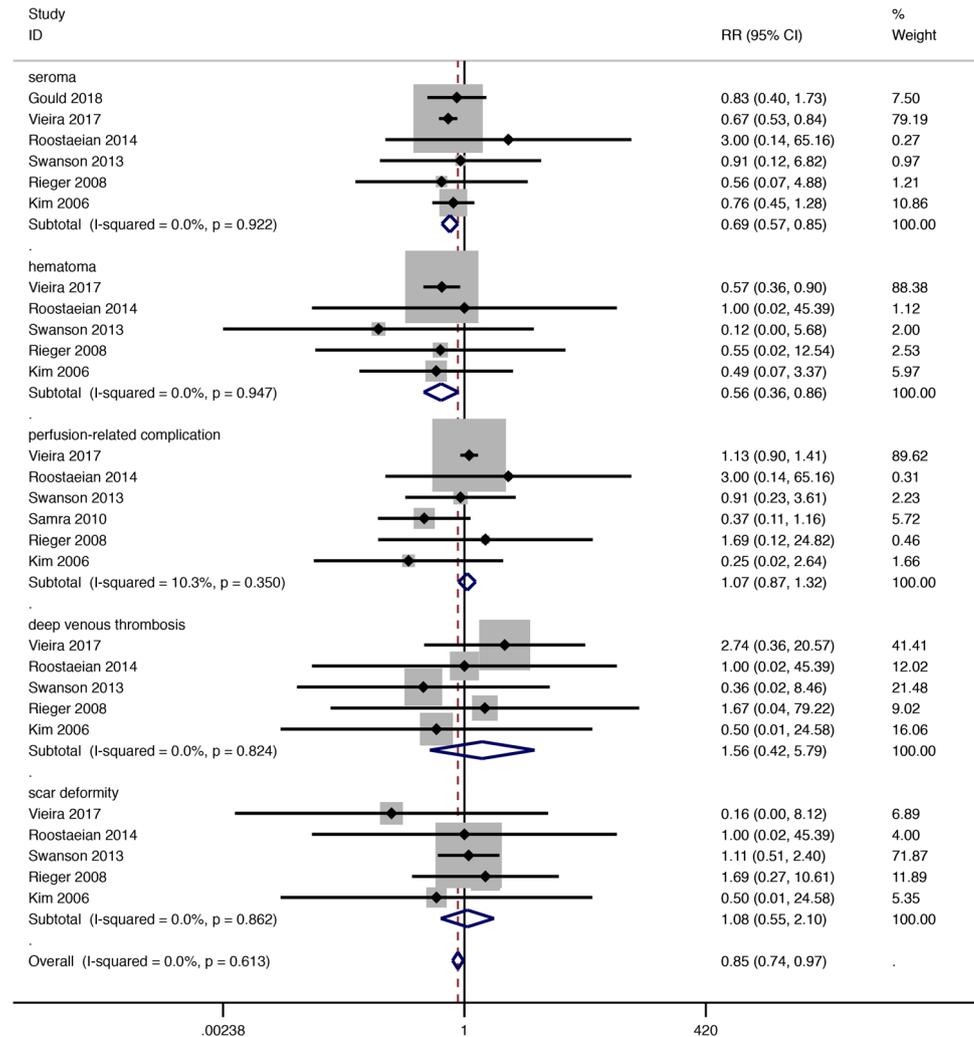
LG lipoabdominoplasty group, AG abdominoplasty group, NP not reported

On the other hand, the subcutaneous tissue of the abdominal wall contains two distinct fat compartments, separated by the Scarpa fascia. While preserving the Scarpa fascia, the deep fat compartment along with its connective tissue, lymphatic vessels, arteries, and veins is also retained. Hence, retention of the Scarpa fascia is recommended, which preserves the inferior perforating vessels and deep lymphatic vessels, offers better adherence between the deep layers and flap, and provides smaller scars laterally [20].

Some studies have confirmed the safety of lipoabdominoplasty; for example, Vieira et al. [31] included 11,191 people to determine the effect of lipoabdominoplasty ($n = 9638$) on complications compared with traditional abdominoplasty ($n = 1553$). The total incidence of complications was 10.5% and 13.0%, respectively. Lipoabdominoplasty can reduce the risk of overall complications ($p = 0.046$) and seroma ($p = 0.030$) effectively. Our meta-analysis incorporates seven cohort studies, with results favoring fewer complications, especially seroma and hematoma. Likewise, lipoabdominoplasty did not achieve a statistically significant reduction in deep venous thrombosis; scar deformity; or perfusion-related complications, including wound infection, dehiscence, and fat necrosis, which means that lipoabdominoplasty may not increase the risk of these complications. Thus, we conclude that lipoabdominoplasty is a safe procedure and is associated with fewer complications compared with traditional abdominoplasty.

This meta-analysis has several limitations. Firstly, no RCTs met the inclusion criteria, and the pooled results should be interpreted with caution. Secondly, the included studies have many dissimilar variables, such as follow-up duration, BMI, the amount of liposuction, and the length of surgery. The pooled results may have some heterogeneity, and the results are not sufficiently reliable. Thirdly, the current research is not registered on the PROSPERO and may have small deviation, but we still follow the procedure of systematic review strictly. Fourthly, since there is no unified standard for the determination of complications, the number of detailed reports on patients' complications may not be accurate, which may lead to publication bias. Finally, the surgical technique used by the different authors is also a bias. To better understand and evaluate lipoabdominoplasty compared to traditional abdominoplasty, case-control studies or RCTs are needed with a huge number of patients, very limited inclusion and exclusion criteria, the same technique used for all of them and last but not least a homogenous population.

Fig. 2 Forest plot demonstrating the risk ratios of the lipoabdominoplasty group and abdominoplasty group with a fixed effects model meta-analysis. M–H, Mantel–Haenszel



Conclusions

Lipoabdominoplasty is a valuable tool for perfecting body shape. This meta-analysis, which summarized the results of clinical trials, showed that it is associated with fewer complications compared with traditional abdominoplasty. In the future, more high-quality prospective studies are needed to explore a higher level of evidence.

Compliance with Ethical Standards

Conflict of interest The authors certify that no competing interests exist.

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