

A Systematic Review and Meta-analysis of Free-style Flaps: Risk Analysis of Complications

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Background: Free-style flaps allow surgeons to overcome anatomical variations and raise perforator flaps wherever a pulsatile signal can be detected. We performed a systematic review and meta-analysis to identify the risk factors for complications and indications for free-style flaps in soft-tissue defect reconstructions.

Methods: This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. The databases of MEDLINE, PubMed, ScienceDirect, and Cochrane Library were searched from January 1991 to January 2017 for original articles describing free-style flaps in soft-tissue defect reconstruction.

Results: A total of 17 articles met the inclusion criteria, representing 453 free-style flaps. The percentage of free-style flaps conducted after primary oncologic resection was 54.4% (246/453). Free-style flaps were mostly used in the head and neck region (35.5%), and most of them were designed as pedicled perforator flaps (96.7%). Complete flap survival was accomplished in 91.8% of the free-style flaps. Complications were found in 13.5% of cases, and 2 risk factors were identified: extremity defects (risk ratio, 2.39; $P = 0.006$) and single perforator flaps (risk ratio, 4.93; $P = 0.002$). No significant differences were found among the criteria including patients aged greater than 60 years, female gender, chronic etiology, flap size over 100 cm², flap rotation, or perforator skeletonization.

Conclusions: Free-style flaps are both reliable and advanced forms of perforator flaps for use in soft-tissue defect reconstructions. Defects located on the extremities and flaps with single perforators are risk factors for flap failure and complications. (*Plast Reconstr Surg Glob Open* 2018;6:e1651; doi: 10.1097/GOX.0000000000001651; Published online 8 February 2018.)

INTRODUCTION

Since the first introduction by Koshima and Soeda¹ in 1989, perforator flaps soon gained popularity for their use in soft-tissue reconstructions, having the advantage of preservation of the underlying muscles, therefore saving the motility of the donor site. Usually, perforator flaps are planned following the guidelines of angiosome mapping, as introduced by Taylor and Palmer.² Although the anatomical study of Taylor and Palmer² indicated that there were more than 300 cutaneous perforators with diameters greater than 0.5 mm, adequate flap planning can some-

times be difficult, with respect to enabling a “like with like” reconstruction.³

With the development of microsurgery and super-microsurgery, which allowed micro-neurovascular dissection and anastomosis for small vessels less than 0.3–0.8 mm, the applications of perforator flaps were extended.⁴ Mardini et al.⁵ introduced free-style free flaps in 2003. The free-style concept entails localization of skin perforators using a hand-held Doppler, and raising perforator flaps by performing retrograde dissection until a sufficient pedicle length and size have been achieved regardless of the origin of the vessel. The free-style technique was modified into a local flap technique and has been used in almost every region of the body.

Although free-style perforator-based flaps are highly technique based, they achieve the goal of obtaining the best possible match in flap color, thickness, and texture, while simultaneously minimizing donor-site morbidity. Without the necessity of knowing the origins of the perforator, raising a flap in free-style manner obviates the need

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for patients to have expensive and time-consuming imaging examinations.⁵⁻⁸

To better place such flaps in the reconstructive decisional algorithm, a systematic review and meta-analysis was performed to estimate complication rates and identify patients with a significant risk of flap complications or failures. Finally, recommendations for flap indications and patient selection based on this study were presented.

METHODS

This review was conducted in accordance with the Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0⁹ and implemented in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement.¹⁰ A protocol was previously registered in the International Prospective Register of Systematic Reviews, PROSPERO (identification code CRD42017065421).

Inclusion Criteria

All original studies reporting the use of free-style flaps were included, within which the definition of “free-style” would have met the definition described in the introduc-

tion. Articles without specific data about each patient were excluded, as were case reports, reviews, purely technical descriptions, editorials, or letters. Studies from the same institution with verified, identical, duplicated data were excluded.

Search Strategy

The database of PubMed, MEDLINE, ScienceDirect, and Cochrane Library were searched from January 2003 (first description of the technique) to January 2017. The following search term was used for each database: ((free-style[All Fields] OR “free style”[All Fields]) OR freestyle[All Fields]) AND (“surgical flaps”[MeSH Terms] OR (“surgical”[All Fields] AND “flaps”[All Fields]) OR “surgical flaps”[All Fields] OR “flaps”[All Fields]). Only English language articles were reviewed. Information from the included studies was recorded using Microsoft Excel 2016.

Data Extraction and Study Appraisal

Data extraction was performed by 2 researchers independently, and disagreements were resolved by consensus. If consensus could not be achieved, 1 of the senior authors

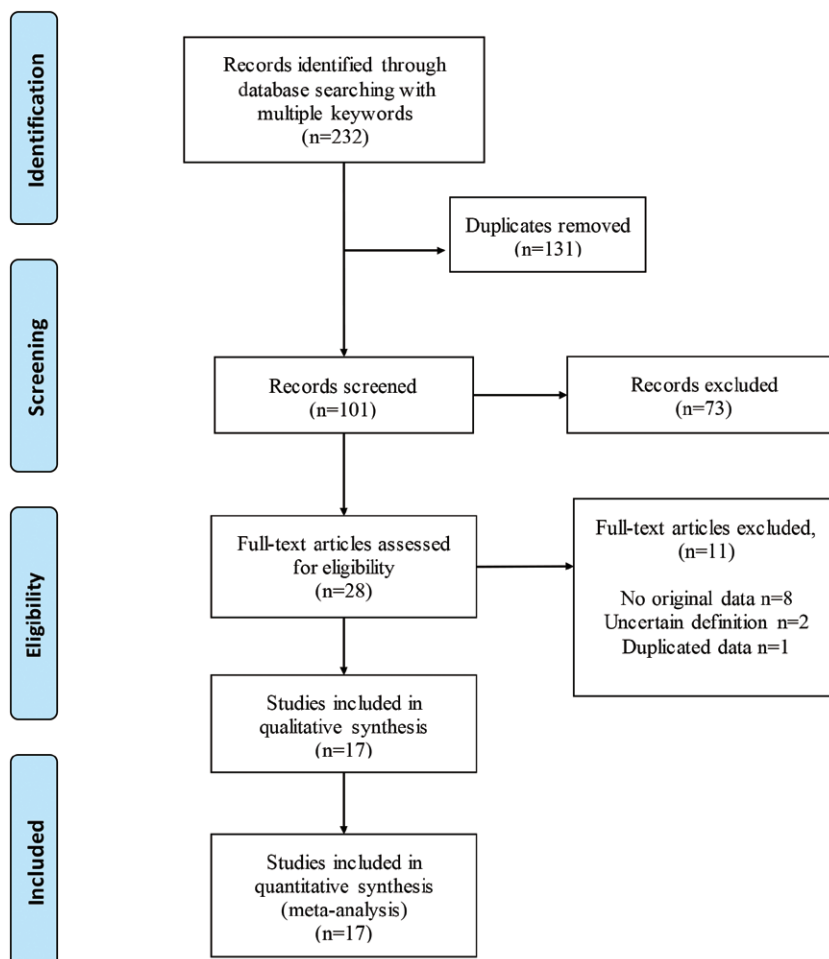


Fig. 1. PRISMA flow diagram of literature search and selection process. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analysis.

Table 1. Overview of Included Studies

Study	No. Cases	Age (Mean)	Type of Flap	Surgical Technique			Donor Site	Complications
				Size (cm ²)	Dissection	No. Perforators		
Wei and Mardini ⁶	13	49.0	FF	108.0	Supra-fascial	Single	Primary closure	15.4% (n = 2) hematoma (n = 1) partial necrosis (n = 1)
Yildirim et al. ¹²	26	48.3	PPF	128.0	ND	Single (n = 7); multiple (n = 19)	Primary closure	26.9% (n = 7) venous congestion (n = 4) total necrosis (n = 1) partial necrosis (n = 1) dehiscence (n = 1)
Bhat et al. ¹³	11	36.3	PPF	81.3	Sub-fascial	ND	Primary closure (n = 2) skin graft (n = 9)	27.3% (n = 3) partial necrosis (n = 2) dehiscence (n = 1)
Bravo and Schwarze ¹⁴	21	57.8	PPF	271.3	Supra-fascial	Single (n = 6); multiple (n = 15)	Primary closure (n = 4) skin graft (n = 4)	9.5% (n = 2) dehiscence (n = 2)
D'Arpa et al. ¹⁵	8	75.0	PPF	ND	ND	Single	ND	12.5% (n = 1) partial necrosis (n = 1)
Lecours et al. ¹⁶	53	54.1	PPF	124.0	ND	Single	Primary closure (n = 37) skin graft (n = 15) local flap (n = 1)	15.1% (n = 8) partial necrosis (n = 3) total necrosis (n = 2) infection/dehiscence (n = 1) hematoma (n = 2)
D'Arpa et al. ¹⁷	85	76.0	PPF	55.0	Supra-fascial	Single	ND	7.1% (n = 6) total necrosis (n = 1) partial necrosis (n = 3) venous congestion (n = 2)
Eom, 2011	10	55.0	PPF	98.4	Sub-fascial	Single	Primary closure	40% (n = 4) partial necrosis (n = 1) venous congestion (n = 2) hematoma (n = 1)
Yang et al. ¹⁹	37	62.7	PPF	56.4	Sub-fascial	ND	ND	18.9% (n = 7) total necrosis (n = 1) partial necrosis (n = 3), dehiscence (n = 3)
Brunetti et al. ²⁰	40	63.0	PPF	38.8	Supra-fascial (n = 24) subfascial (n = 16)	Single (10); multiple (30)	ND	7.5% (n = 3) partial necrosis (n = 3)
Feng et al. ^{21*}	13	ND	FF (n = 1); PPF (n = 12)	34.6	ND	ND	Primary closure	7.7% (n = 1) failed
Hashimoto et al. ²²	5	59.0	PPF	84.2	Sub-fascial	Single	Primary closure	No complications
Knieser et al. ²³	10	53.4	PPF	139.4	ND	Single	Primary closure	20% (n = 2) partial necrosis (n = 2)
Gunnarsson et al. ²⁴	34	64.6	PPF	69.1	Supra-fascial	ND	Primary closure	21% (n = 7) partial necrosis
Ioannidis et al. ²⁵	14	44.3	FF (n = 1) PPF (n = 13)	137.0	ND	ND	ND	7.1% (n = 1) dehiscence (n = 1)
Lee et al. ²⁶	17	63.0	PPF	4.6	ND	ND	Primary closure	23.5% (n = 4) partial necrosis (n = 1) congestion (n = 3)
Kokkoli et al. ²⁷	30	62.0	PPF	11.9	ND	ND	Primary closure (n = 22) skin graft (n = 1)	No complication
	23*	61.1	PPF	34.3	ND	ND	Primary closure	13% (n = 3) total necrosis (n = 3)

*Studies with secondary flap. FF, free flap; ND, not determined; PPF, pedicled perforator flap.

Table 2. Characteristics of Patients and Flaps

Features	Cases (%)
Age (y)	
< 20	7 (1.9)
≥ 20, < 40	36 (9.8)
≥ 40, < 60	131 (35.6)
≥ 60	194 (52.7)
Flap size (cm ²)	
< 50	231 (52.0)
≥ 50, < 100	93 (20.9)
≥ 100, < 150	51 (11.5)
≥ 150	70 (15.8)
Cause of defect	
Acute etiology	332 (76)
Chronic etiology	104 (24)
Location of defect	
Head and neck	161 (36)
Trunk	101 (22)
Lower extremity	95 (21)
Perineal	65 (14)
Gluteal to upper extremity	31 (7)
Type of flaps	
Free flaps	15 (3)
Pedicled flaps	438 (97)
Dissection plane	
Supra-fascial	171 (68)
Sub-fascial	79 (32)
Number of perforators	
Single	207 (76)
Multiple	64 (24)
Skeletonization of the perforator	
Yes	90 (38)
No	148 (62)
Donor site	
Primary closure	239 (89)
Skin graft	17 (6)
Partial skin graft	12 (4)
Flap	1 (1)

was asked to make the final decision. The data collected included the following information: age, gender, location and cause of the defect, type and size of the flap, subfascial or supra-fascial dissection, number of perforators, presence or absence of perforator skeletonization, closure of the donor site, and complications.

The quality of identified studies was assessed by The Joanna Briggs Institute Critical Appraisal Checklist for Case Series,¹¹ which evaluates the quality of case series on the basis of 10 criteria.

Statistical Analysis

Differences were expressed as risk ratio (RR) with its 95% confidence intervals (CIs) for dichotomous variables. The I² statistic was used to assess statistical heterogeneity. A fixed-effects model was used when I² was less than 50%, otherwise a random-effects model was used. The Mantel-Haenzel method was used for the analysis. Publication bias was assessed by using a funnel plot if more than 10 studies were included. A symmetrical funnel shape suggested that publication bias was unlikely. Statistical analysis was conducted by Review Manager (RevMan Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014). A P value of 0.05 or less was considered to be statistically significant.

RESULTS

A total of 232 references were identified through our search strategy, from which 17 studies^{6,12-27} met the inclusion criteria (Fig. 1). The included studies had a total of

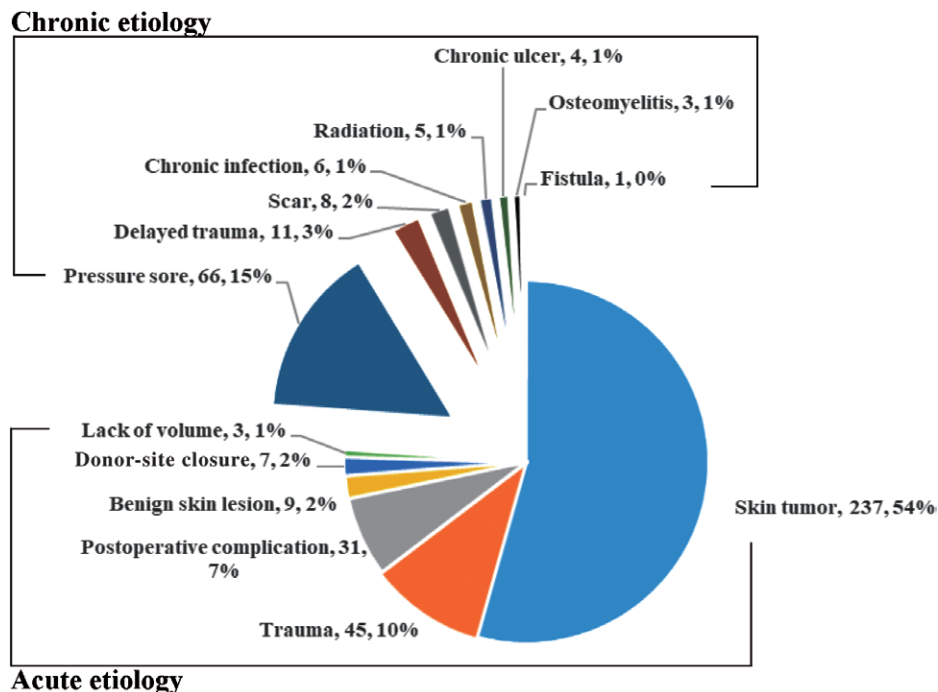


Fig. 2. Distribution of deflection causes (presented with case numbers and percentage).

418 patients (212 male patients and 206 female patients) with soft-tissue defects, and 453 free-style perforator flaps were performed (Table 1). The mean age of the patients was 58.2 years old. Characteristics of patients and flaps are shown in Table 2.

Overview of Practices

Cause of the Defect

Causes of the soft-tissue defects (n = 436) were divided into acute and chronic groups. Skin tumor (n = 237, 54.5%) was the most common cause of soft-tissue defects. The specific etiologies are shown in Figure 2.

Location of the Defect

In our study, we observed that defects over the entire body could be reconstructed by free-style flaps, from head and neck (n = 161, 35.5%), trunk (n = 101, 22.3%), lower extremity (n = 95, 21.0%), perineal and gluteal (n = 65, 14.3%) to upper extremity (n = 31, 6.8%).

Flap Type

Free-style perforator flaps were divided into 2 general types: free flaps (n = 15, 3.3%) and pedicled flaps (n = 438, 96.7%). According to the surgical procedure, pedicled flaps contained propeller flaps (n = 169, 46.8%), rotation flaps (n = 54, 15.0%), rotation and advancement flaps (n = 5, 1.4%), advancement flaps (n = 129, 35.7%), and simple island flaps (n = 4, 1.1%).

Flap Size

The size of free-style flaps represented in our study was $78.6 \pm 87.6 \text{ cm}^2$ (mean \pm SD). Most of the flaps were small to moderate flaps with size $< 100 \text{ cm}^2$ (n = 324, 72.8%).

Dissection Plain

There were 9^{6,13,14,17–20,22,24} included studies describing the dissection plane. In 68.4% (n = 171) of cases, the flaps were raised on the supra-fascial plane, whereas the other 31.6% (n = 79) were dissected to the sub-fascial plane.

Number of Perforators

Most of the flaps studied relied on a single perforator (n = 207, 76.4%), while multiple perforator flaps (n = 64, 23.6%) were also adopted in 3 studies.^{12,14,20}

Skeletonization of the Perforator

In 62.2% (n = 148) of the cases, the perforator was not skeletonized. For the rest of the cases (n = 90), skeletonization was necessary to gain sufficient pedicle length.

Donor-site Closure

Primary closure was possible in the majority of the flaps (n = 239, 88.8%). Some donor sites needed a skin graft (n = 17, 6.3%) or a partial skin graft (n = 12, 4.5%), and only 1 case needed another flap to cover the donor site.

Table 3. Complications of Free-style Flaps

Complications	Cases (%)
Partial necrosis	28 (6.2)
Transient venous congestion	10 (2.2)
Wound dehiscence	9 (2.0)
Complete necrosis	9 (2.0)
Hematoma	4 (0.9)
Arterial insufficiency	1 (0.2)

Complications

Complete flap survival was accomplished in 91.8% (416/453) of flaps and 13.5% (61/453) of flaps had flap related complications. The most common complication was partial necrosis, followed by transient venous congestion, wound dehiscence, complete necrosis, hematoma formation, and arterial insufficiency. Complication-related morbidities are shown in Table 3. Donor-site-related complications were also recognized in 1 case of skin slough and another in a case of infection.

Meta-analysis of Risk Factors for Complications

Extremity Defects

Nine studies were included for the analysis of defects located on the extremities, where there was a significant difference between extremity defects and defects in other parts of the body, with regard to complications (RR, 2.39; 95% CI, 1.28–4.45; $P = 0.006$; Fig. 3).

Single Perforator

To compare single perforator flaps with multiple perforator flaps, a total of 3 articles were included. The statistical analysis showed a significantly increased risk of complications (RR, 4.93; 95% CI, 1.81–13.43; $P = 0.002$) for single, compared with multiple perforator flaps (Fig. 4).

Age Older than 60 Years

A total of 14 articles were included for the analysis of patients aged greater than 60 years, and no significant differences were found between the patients older than, or younger than age 60 years (RR, 1.05; 95% CI, 0.64–1.75; $P = 0.86$). A subgroup analysis was conducted for free-style pedicled flaps, and still no significant differences were found (RR, 1.07; 95% CI, 0.65–1.77, $P = 0.78$; Fig. 5).

Female Gender

Twelve articles were combined to compare the risk of complications between female patients and male patients, and no significant differences were found (RR, 1.10; 95% CI, 0.67–1.80; $P = 0.70$; Fig. 6).

Chronic Etiology

Ten studies were included for the risk analysis in the chronic etiology of the defects. The statistical analysis showed no significant increase of complication risk for chronic etiology (RR, 1.32; 95% CI, 0.71–2.46; $P = 0.39$; Fig. 7).

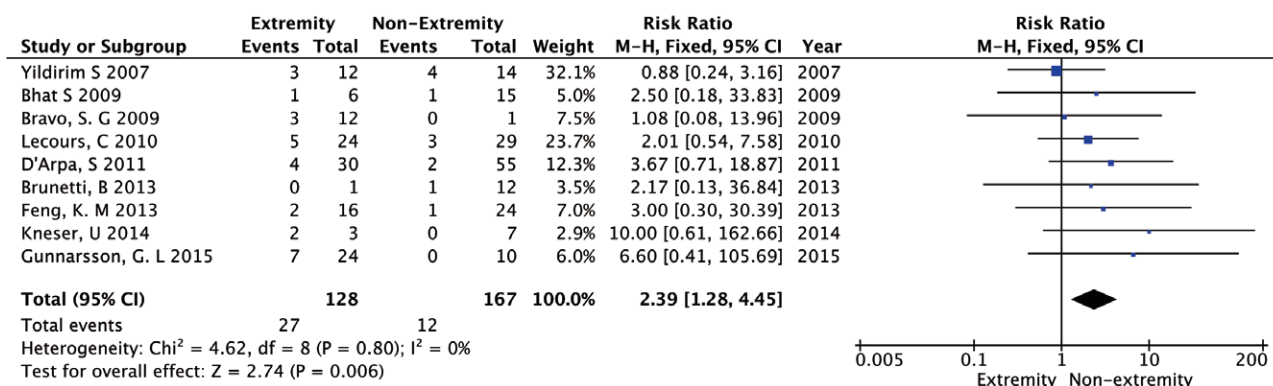


Fig. 3. Forest plot for complication risk analysis of defects located on extremities.

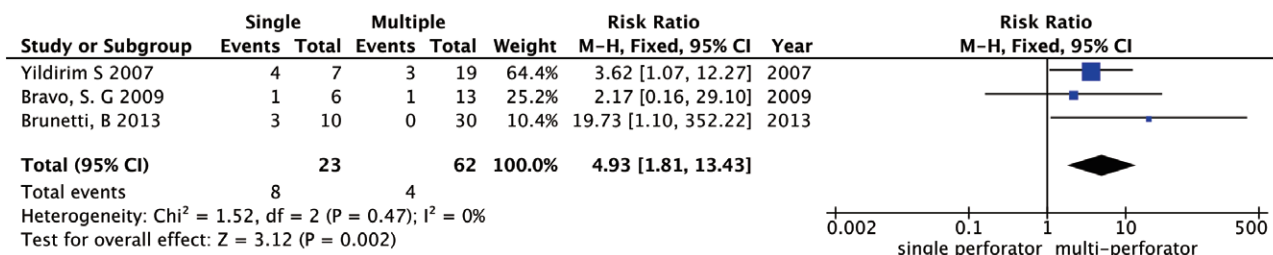


Fig. 4. Forest plot for complication risk analysis of flaps with single perforator.

Flap Size over 100 cm²

Thirteen articles that contained information about flap surface were included for the analysis. There were no significant differences between flap size larger or smaller than 100 cm² (RR, 1.35; 95% CI, 0.81–2.26; P = 0.25). A subgroup analysis was conducted for free-style pedicled flaps, and still no significant differences were found (RR, 1.25; 95% CI, 0.74–2.11; P = 0.41; Fig. 8).

Flap Rotation

A total of 7 articles were included in an analysis of flap movement, and there were no significant differences found between rotation and advancement flaps (RR, 1.42; 95% CI, 0.56–3.63; P = 0.46; Fig. 9).

Perforator Skeletonization

Only 2 articles met the criteria for the analysis of perforator skeletonization. The statistical analysis showed no significant increase in complication risk for skeletonizing the perforators (RR, 5.36; 95% CI, 0.71–40.52; P = 0.1; Fig. 10).

Publication Bias

A funnel plot analysis was used to examine publication bias. No significant publication bias was found in the meta-analysis.

DISCUSSION

In reconstructive plastic surgery, perforator flaps have become increasingly popular among surgeons since the first description by Koshima and Soeda¹ in 1989. Taylor and Palmer² mapped 374 cutaneous perforators greater

than 0.5 mm to the human body, and using the angiosome concept, numerous flap types have been described in the literature over the last 3 decades.²⁸ Perforator flaps spare the underlying muscles and fascia, therefore minimizing the aesthetic, or functional donor-site morbidity. And for the same reason, perforator flaps are usually thin, pliable, and easily moldable flaps that provide better aesthetic results, which is ideal in areas that require more cosmetic attention, such as the head and neck region.

With the increasing safety of perforator-based surgery, and the expertise of performing surgeons, the concept of free-style free flap surgery, as an advanced form of flap harvest was introduced by Mardini et al.⁵ in 2003. Free-style flaps provide a greater freedom in flap planning since flap harvest could be carried out in any anatomical area where the Doppler signal of a sizable perforator vessel could be detected. Free-style flaps may really achieve the goal of choosing the donor site that best fits the defects or the patients' satisfaction. To a certain extent, the retrograde procedure can also spare surgeons from having to know the complicated underlying source vessels.²⁹

Despite all the advantages that free-style flaps have, the safety of free-style flaps has not been thoroughly researched. Our study showed that to date there had not been any systematic research or meta-analysis as to the application of free-style flaps yet.

Indications

One of the biggest advantages of the free-style is that flaps can be chosen from all over the body, which was well observed in our study. It was also observed that free-style flaps were most commonly used in the head and neck region. This region was critical to the patients' appearance

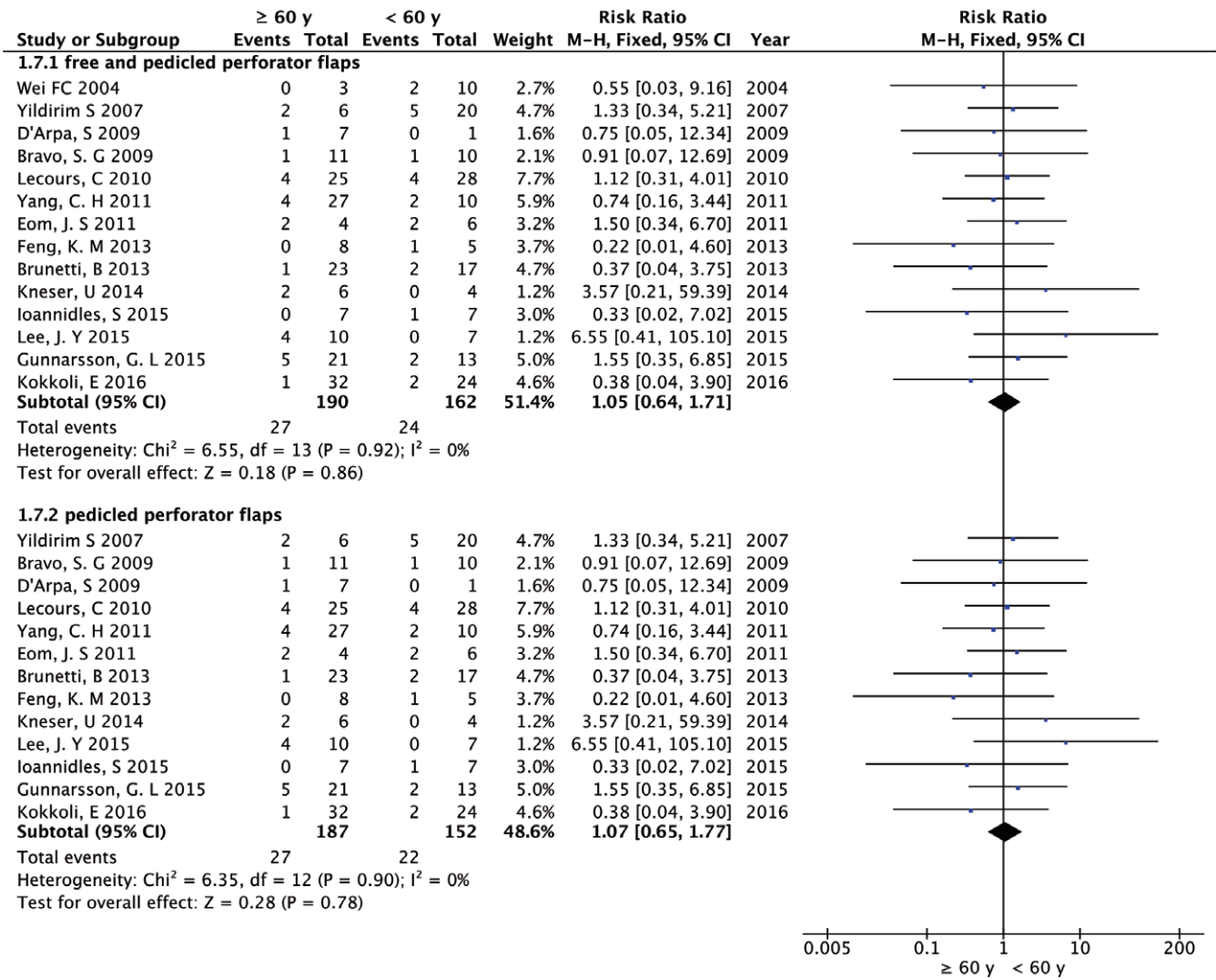


Fig. 5. Forest plot for complication risk analysis of patients' age older than 60 years.

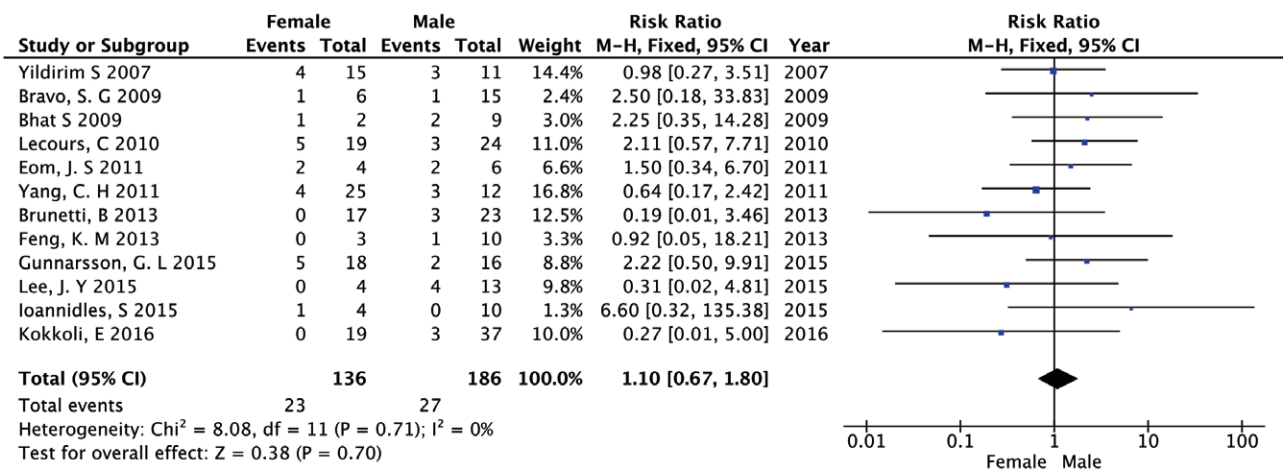


Fig. 6. Forest plot for complication risk analysis of female gender.

and satisfaction, therefore demanding of better aesthetic outcomes. Free-style flaps suit the head and neck region well by achieving better aesthetic outcome by a “like with like” reconstruction.

Complications

According to our study, flap survival was accomplished in 91.8% free-style flaps. The most common postoperative complication of free-style flap was partial necrosis (6.2%),

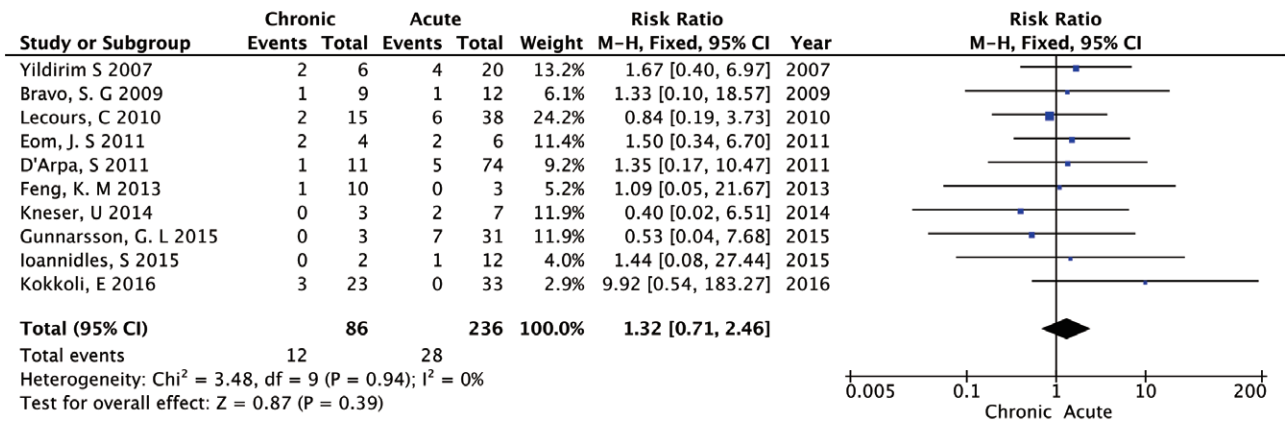


Fig. 7. Forest plot for complication risk analysis of chronic etiology.

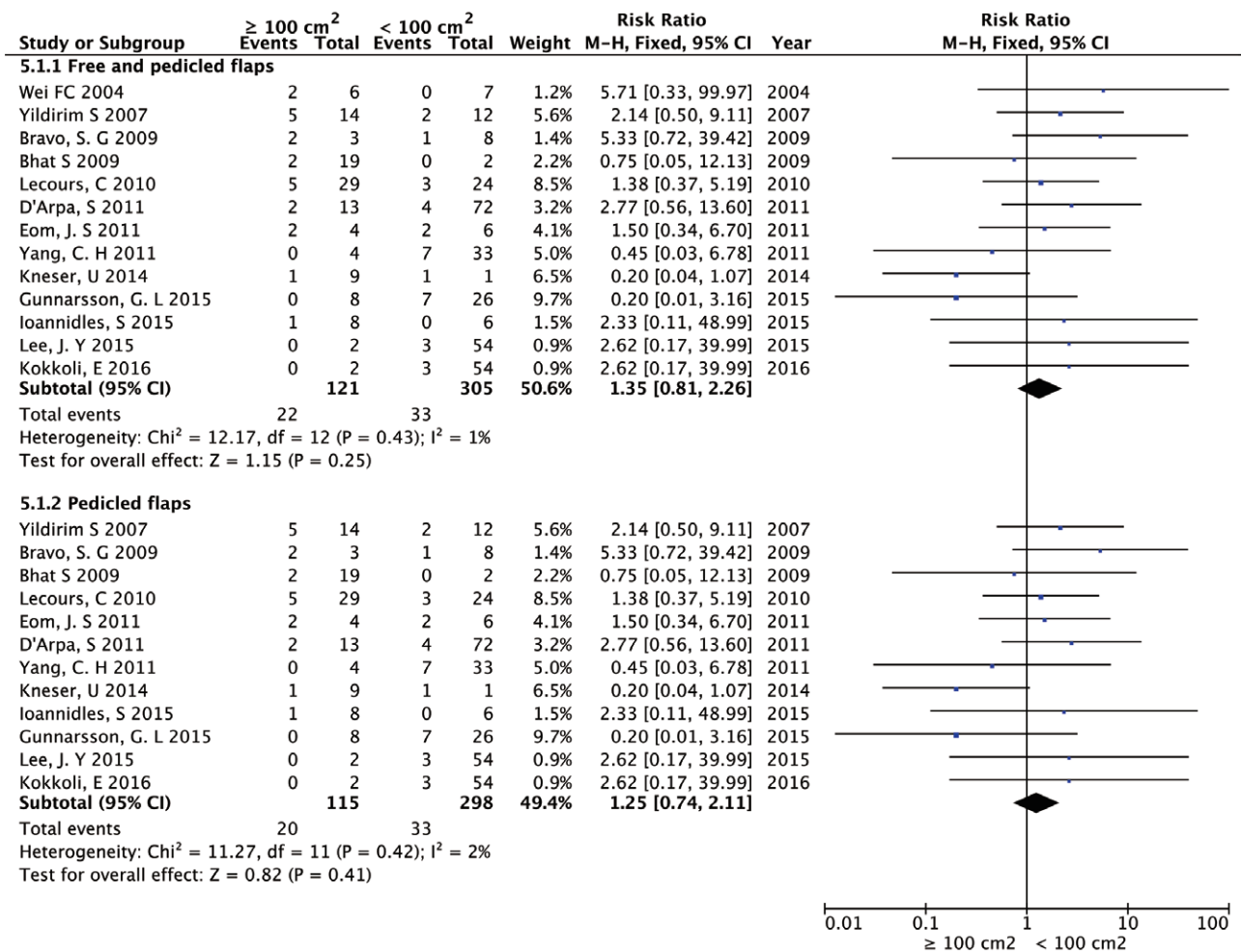


Fig. 8. Forest plot for complication risk analysis of flap size over 100 cm².

followed by transient venous congestion, wound dehiscence, complete necrosis, hematoma formation, and arterial insufficiency. Generally, free-style flaps are considered as a last resort for use when established flaps, whether they be pedicled or free in design, are not options. However, in the era of form and function, simplest is not necessarily always the best. Based on the available statistics, there

was no striking increase in flap failure, or complication of free-style perforator flaps, compared with conventional perforator flaps, in soft-tissue reconstruction. Therefore, we believe that the free-style pedicled flap, which requires little microsurgical technique, could be considered before established free flaps in the reconstructive ladder, especially for the head and neck region.

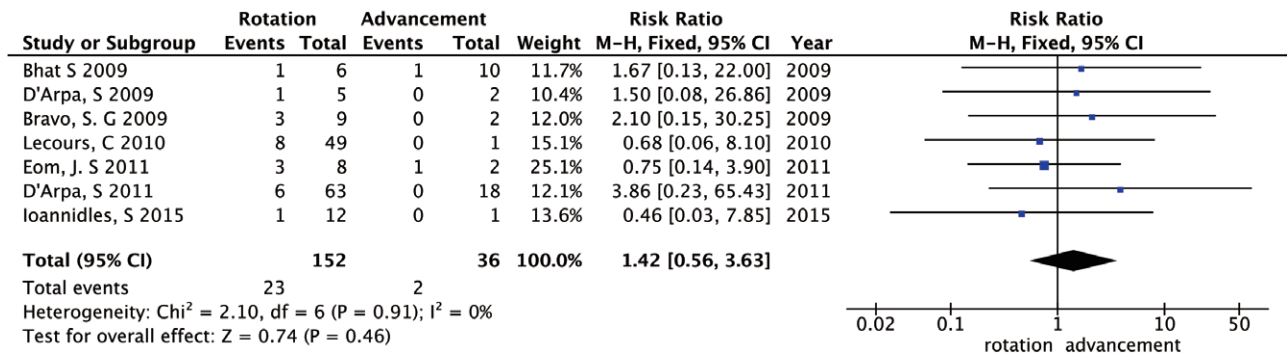


Fig. 9. Forest plot for complication risk analysis of flap rotation.

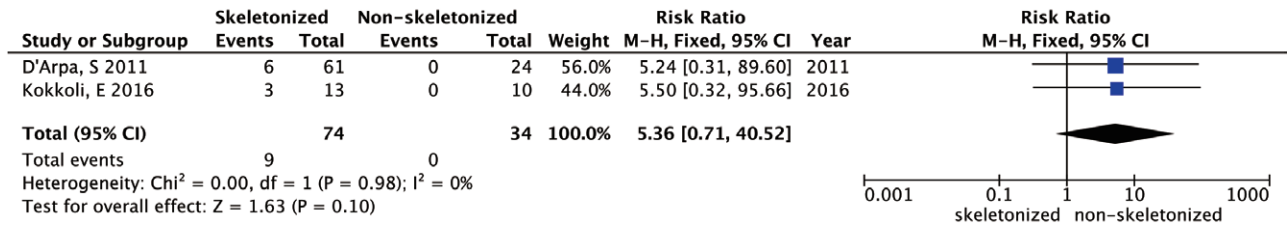


Fig. 10. Forest plot for complication risk analysis of perforator skeletonization.

Risk Analysis of Complication

Defects' Location

Defects located on the extremities are often bigger and lack local tissue, which makes reconstruction a challenge. According to our study, extremity defects would raise the risk of postoperative complications compared with defects located in other regions. Of all the extremity defects reconstructed with free-style flaps, 21.4% had complications and 2.4% ended up total necrosis. When encountering extremities with defects, we recommend surgeons to thoroughly consider all the options for reconstruction, then choose cautiously based on patient need and the experience and technical ability of the surgeon.

Number of Perforators

The preservation of perforators largely depends on the design of the flap, and more perforators usually mean better perforation, but also more restriction on flap movement. In our observation, although most of the flaps relied on single perforator (76.4%), a pooled risk analysis of these 3 articles showed that multiple perforators might be a protective factor in free-style pedicled flaps, in terms of complications. Although the statistics were limited and needed further exploration, we suggest that the pedicled flap should preserve more than 1 perforator as long as conditions allow. We recommend that during the preparation of the free-style pedicled flap, all sizable perforator signals within the flap margins should be marked, carefully dissected, and preserved until the last minute.

Flap Type

The concept of free-style flaps first came up with free perforator flaps, and soon expanded to local perforators. After Morris et al.³⁰ reported successful closure of soft-tissue defects with free-style local perforator flaps, the ap-

plication gained in popularity. In our study, there was only 1 article about free flaps that meet the inclusion criteria. With the lack of sufficient statistics, it was hard to compare free-style free flaps and free-style pedicled flaps, but there did seem to be a preference of pedicled flaps over free flaps. The fact that free-style pedicled flaps can avoid time consuming microsurgical anastomosis while maintaining the advantages of the free-style manner, facilitates the procedure preference. Our statistical analysis also showed that flap rotation did not increase the complication risk when compared with advanced flaps. Nevertheless, planning a free-style pedicled flap according to the reconstructive ladder concept was recommended by Brunetti et al.²⁰ to optimize the outcome. This means starting from simpler options (V-Y advancement perforator flaps, propeller flaps with reduced rotational angles) and increasing the level of technical difficulty (180 degrees propeller flaps) only when the clinical situation requires it.

Flap Size

Wei suggested that the skin dimensions of a free-style flap based on a single perforator were limited to 8 cm by 20 cm.⁷ We observed that the size of the flaps in our research ranged from 0.4 to 510.0 cm², with most of them being less than 100 cm² (72.8%). However, flap sizes greater than 100 cm² did not increase the risk of complication, according to our analysis of 13 articles, which indicates that free-style flaps are suitable for larger defects, as well as small-to-moderate defects. The other limiting factor in choosing flap size is donor site closure, which is important for gaining a better cosmetic appearance and preserving function of the donor site. In our research, 88.8% of donor sites underwent primary closure, while some needed total or partial skin grafts, and only 1 case needed another flap. Of all the cases, only 1 reported a

donor-site infection, and another 1 reported donor-site skin slough. With the increasing survival rate of free-style flaps, donor-site closure might be the biggest restrictive factor in flap size.

Patient's Age and Gender

With regard to patients' over age 60 years old, or female patients, the statistical analysis showed no sign of an increased risk of complications. For elderly patients, who usually have more underlying diseases and poorer vessel condition, more complications were expected. However, our analysis showed no significant differences among the elderly, even when we changed the threshold of age to greater than 70 years (pooled relative risk, 0.93; 95% CI, 0.53–1.65; $P = 0.81$). Other information, such as patients' BMI, smoking status, and comorbidities, were also important factors affecting the postoperative complication rates, which we were not able to analyze because of a lack of statistics.

Chronic Etiology

Chronic etiology was mostly a function of pressure sores and chronic infection, which were often challenging for reconstructions. The fact that it did not turn out to be a risk factor for complications in free-style flaps indicated that free-style perforator flaps were good for pressure sore and chronic infections. Another reason why free-style flaps are appropriate for pressure sore reconstruction, is that it results in a smaller operative wound and less donor-site morbidity, preserving options for future reconstruction if the ulcer recurs.¹⁹ This is also an excellent situation with regard to tumor recurrence.

Puzzle Flap

Following the free-style concept, a free-style puzzle flap was presented by Feng et al.²¹ in 2013. This type of flaps is performed by harvesting a recycled local, or free perforator-based flap, from a previous redundant flap where an obvious Doppler signal was detected. This free-style puzzle flap sparked a renewed and creative use of various bulky or redundant flaps for coverage of difficult defects in a second reconstruction, minimizing donor-site morbidity, which is very important, especially in the cancer population.²⁷

Our study had several limitations. First, the quality of a meta-analysis typically depends on the quality of the studies included. Studies that met our inclusion criteria were all case series, which therefore made our study observational in nature. A randomized controlled trial is desirable but would be difficult to perform. Second, free-style perforator-based flaps are highly technically based, and the reports that we reviewed were performed by different surgeons with different surgical techniques that were highly varied, and not standardized. Third, there were missing data regarding patients' comorbidities, pedicle lengths, dissection planes, perforator skeletonizations, and operation times. Finally, only experienced microsurgeons are recommended to perform free-style flaps nowadays, which might cover up the rates of morbidity associated with the flap procedure.

CONCLUSIONS

Free-style perforator flaps are reliable and advanced flaps for all kinds of soft-tissue reconstruction all over the body. There are no specific restrictions on flap size, except with respect to donor-site closure. We found 2 risk factors for flap complications including defects located on the extremities and flaps relying on a single perforator. Hopefully, this study will promote some thoughts as to modifications of the indications for free-style perforator flaps in the future.

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