Donor-site Morbidity of Medial and Lateral Thigh-based Flaps: A Comparative Study

Chad A. Purnell, MD*
Kevin C. Lewis, BS*
Lauren M. Mioton, MD*
Philip J. Hanwright, MD†
Robert D. Galiano, MD*
Gregory A. Dumanian, MD*
Mohammed S. Alghoul, MD*

Background: Free and pedicled medial and lateral thigh-based flaps are common reconstructive procedures. However, there have been no comparative studies of morbidity between medial and lateral donor sites.
Methods: We conducted an Enterprise Data Warehouse-based review of all the senior authors' (R.D.G., G.A.D., and M.S.A.) thigh-based free and pedicled flaps. Patient demographic data, donor-site complications, drain duration, and number of postoperative visits were collected and compared. Complications were also compared between fasciocutaneous flaps and muscle or myocutaneous flaps, and skin grafted donor sites.
Results: We analyzed 352 flap donor sites, with 155 medial and 197 lateral. Two hundred seventeen (217) flaps were pedicled. Flap types included 127 gracilis, 27 rectus femoris, 134 anterolateral thigh, and 36 vastus lateralis-only flaps. There were no significant differences in complications between medial (17.4%) and lateral thigh (21.3%) donor sites, although lateral thigh flaps had a mean of 1 additional postoperative visit. Rates of wound dehiscence/healing issues were significantly higher in both gracilis myocutaneous flaps (25.9%) and flaps requiring a skin grafted donor site (31.2%). Postoperative therapeutic anticoagulation was the only significant risk factor for a donor-site complication. Flap complications resulted in increased drain duration and postoperative office visits.
Conclusions: Donor-site morbidity is similar in both lateral and medial thigh-based flaps. The inclusion of muscle in the flap from either donor site does not seem to increase complications, but the inclusion of a skin paddle with gracilis muscle, or a skin grafted lateral thigh donor site, results in increased wound healing complications. *(Plast Reconstr Surg Glob Open 2016;4:e1012; doi: 10.1097/GOX.0000000000001012; Published online 8 November 2016.)*

Free and pedicled medial and lateral thigh-based flaps are an essential part of the reconstructive plastic surgeon's armamentarium. Gracilis, anterolateral thigh (ALT), vastus lateralis, and rectus femoris flaps have been described for numerous indications, including breast, groin, and extremity reconstruction, among other more specialized indications such as facial reanimation.[1–4] When both medial and lateral thigh-based flaps are deemed appropriate reconstructive options, it is prudent to consider donor-site morbidity to aid in the decision-making process and patient education.

A common example is distal lower extremity reconstruction, where both free ALT and gracilis flaps are equally popular. Another example is coverage of vascular bypass graft exposures in the groin, where pedicled flaps based on a patent profunda system are lifeboats for graft salvage. ALT and gracilis flaps are easily dissected and tunneled under the rectus femoris and adductor longus muscles, respectively, to easily reach graft sites, making either an excellent choice for groin coverage. Given their similar abilities to accomplish the reconstructive goal, donor-site complication rates may tip the scale in favor of the other.

To date, there is a paucity of studies comparing donor-site morbidity rates between lateral and medial thigh-based flaps. Previous studies have evaluated individual

thigh-based flap groups separately, with donor-site morbidity rates ranging from 11% to 15% for ALT and vastus lateralis flaps[5,6] and 10% to 12% for gracilis muscle flaps.[7,8] However, significant differences exist between reports as to the types of complications assessed and length of follow-up. No comparative studies exist in the literature with regards to these thigh donor sites.

At our institution, where both gracilis and lateral thigh-based flaps are performed frequently, we anecdotally felt that medial thigh donor sites appeared to have more superficial wound complications, longer duration of drains, and overall more donor-site morbidity. In addition, anatomic dissections have revealed an abundance of lymphatic channels in close proximity to the greater saphenous vein, which could theoretically increase the incidence of lymphatic leak in the medial thigh donor site postoperatively.[9] Therefore, we endeavored to conduct a retrospective review of thigh-based flap donor sites in an effort to evaluate the hypothesis that medial thigh donor sites have a higher rate of incision-related morbidity than lateral donor sites. As a secondary variable, we also assessed the effect of adding a skin paddle on complications at both sites.

METHODS

After institutional review board approval, an Enterprise Data Warehouse-based retrospective review of all the senior authors' (R.D.G., G.A.D., and M.S.A.) free and pedicled flap operations with a medial or lateral thigh donor site was performed. Tensor fascia lata flaps, sartorius flaps, and posterior thigh flaps were excluded from the final patient population due to low numbers that prevented meaningful analysis. Gracilis, vastus lateralis, ALT, and rectus femoris flaps had sufficient numbers to be included for analysis. For the purposes of this study, gracilis muscle was considered a medial thigh flap, whereas ALT, vastus lateralis, and rectus femoris flaps were all considered lateral thigh flaps due to their more lateral donor-site incision. Procedures were conducted at a single large tertiary medical center between the years of 2003 and 2015. Collected variables encompassed procedure-specific details such as flap type, number and duration of drains placed, and presence of skin graft at the donor site. Patient demographic data such as age, body mass index (BMI), comorbidities, and neoadjuvant radiation were also collected. Number of postoperative visits was collected as a general assessment of the amount of outpatient postoperative care a patient required. Complications considered were hematoma, seroma, infection, dehiscence (defined as any opening of the incision, including a superficial opening or even a small area of secondary wound healing), reoperation, and postoperative lymphedema. Flaps performed for all indications were included, and each flap donor site was considered separately when a patient had multiple flaps performed. In the case of both free and pedicled flaps, recipient site complications were not considered. In the case of a flap loss, the donor site was still included in analysis. Data compiled from the retrospective review were deidentified to comply with the Health Insurance Portability

and Accountability Act of 1996 and stored in a password-secured electronic spreadsheet.

Statistical Analysis

SPSS software (IBM Corporation, Armonk, N.Y.) was utilized for statistical analysis. Groups were compared for significant differences. Continuous variables were compared utilizing the independent samples Kruskal–Wallis test or Mann–Whitney U test as appropriate. Nominal variables were compared utilizing the Pearson chi-square test. Medial and lateral flap donor sites were compared for significant differences in complication rates. Flaps were also compared with respect to muscle-only flaps versus those with a skin paddle or skin graft at the donor site. To determine potential risk factors for a donor-site complication in thigh flaps, a univariate analysis was carried out to determine significant differences between flaps with or without a complication of any type. Significance was set at a P value of 0.05, and all tests were 2-tailed.

RESULTS

Overall, 352 patients met inclusion criteria, with 155 medial donor sites and 197 lateral donor sites. Demographic data in these 2 groups are shown in Table 1. Flap numbers overall were as follows: gracilis 127, rectus femoris 27, ALT (including myocutaneous) 134, and vastus lateralis muscle-only 36. There were 135 free flaps and 217 pedicled flaps included in analysis. Medial thigh flaps were significantly more likely to be pedicled (77.4%) and muscle only (88.2%) when compared to lateral thigh-based flaps. There were no other significant differences in patient comorbidities between groups.

Outcome measures with respect to medial or lateral thigh flaps are shown in Table 2. There were no significant differences in complications between medial and lateral thigh donor sites, except for a mean of approximately 1 additional postoperative office visit in lateral thigh patients. Although muscle herniation and compartment syndrome have been described in lateral thigh flap donor sites, these complications were not noted in any patient in this series.[10,11]

Table 1. Demographic Information of Medial versus Lateral Thigh Flaps

	Medial	Lateral	P
Age (y)	65 (13.5)	45 (14)	0.146
BMI	32.8 (6.4)	26.8 (9.9)	0.534
Length of stay (d)	11 (4)	15 (11)	0.547
Free or pedicled			
Free	35 (22.6%)	100 (50.7%)	<0.001
Pedicled	120 (77.4%)	97 (49.2%)	
Flap types			
Muscle	129 (83.2%)	63 (32.0%)	<0.001
Myocutaneous	26 (16.8%)	73 (37.0%)	
Fasciocutaneous	0	61 (31.0%)	
Skin grafted donor site	2 (1.2%)	14 (7.1%)	0.009
No. of smokers	21 (13.5%)	25 (12.7%)	0.332
No. of diabetics	51 (32.9%)	52 (26.4%)	0.128
No. of donor-site drains	1.2 (0.6)	1.7 (0.5)	0.964
Preoperative albumin	2.87 (0.9)	3.32 (1.0)	0.023
Preoperative hemoglobin	10.7 (0.9)	11.3 (1.9)	0.256

Table 2. Comparison of Complications between Medial and Lateral Thigh Flap Donor Sites

	Medial	Lateral	P
30-d readmission	30 (19.3%)	55 (27.9%)	0.06
Hematoma	5 (3.2%)	6 (3.0%)	0.923
Seroma	6 (4.9%)	12 (6.0%)	0.42
Reoperation	3 (1.9%)	11 (5.6%)	0.1
Infection	4 (2.6%)	4 (2.0%)	0.66
Lower extremity lymphedema	0	2 (1%)	0.22
Dehiscence	20 (12.9%)	22 (11.2%)	0.478
Any complication	27 (17.4%)	42 (21.3%)	0.36
Time until drain removal	16.1	12.8	0.964
No. of postoperative visits	3.3	4.1	<0.001

Table 4. Differences between Groups of All Thigh Flaps with or without a Complication

	No Complication (n = 283)	Complication (n = 69)	P
Age	54	59.1	0.126
BMI	27.8	28.2	0.899
Tobacco use			0.305
Never smoker	123 (43.4%)	19 (27.5%)	
Prior smoker	109 (38.5%)	29 (42.0%)	
Current smoker	40 (14.1%)	6 (8.6%)	
Diabetes	77 (27.2%)	26 (37.7%)	0.115
Steroid use	12 (4.2%)	1 (14.4%)	0.27
Postoperative anticoagulation	51 (18.0%)	21 (30.4%)	0.022
No. postoperative visits	3.6	4.8	0.026
Time drains in place	11.9	27.9	0.005

BMI, body mass index.

To determine the effect of harvesting a skin paddle on both lateral and medial donor-site morbidity, flaps were further subdivided into medial thigh muscle, medial thigh with skin paddle, lateral thigh muscle, lateral thigh with skin paddle, and skin grafted donor sites. Comparison of complications between these flap subtypes is shown in Table 3. Rates of wound dehiscence/healing issues were significantly higher in both medial thigh flaps where a skin paddle was harvested (25.9%) and flaps with a skin grafted donor site (31.2%). Furthermore, lateral thigh flaps with a skin paddle and skin grafted flap donor sites had significantly more postoperative visits.

In an effort to determine overall risk factors that may contribute to a complication in any thigh flap, flaps with and without complications were compared. Results of this comparison are shown in Table 4. Only postoperative therapeutic anticoagulation was significantly increased in flaps with complications ($P = 0.022$). The length of time drains were left in place and the number of postoperative visits were significantly increased in patients who had a complication.

DISCUSSION

Since the ALT flap was first described by Song et al[12] in 1984, it has quickly become one of the most popular and well-studied workhorse flaps.[13,14] In our institution, flaps based on the descending branch of the lateral circumflex femoral system are often the first choice for free or pedicled tissue reconstruction for defects of a larger surface area. In turn, the gracilis muscle is our pedicled flap of choice for the majority of vascular graft coverage in the inguinal region and for free tissue transfer for smaller sur-

face area defects.[15,16] We performed this study to test our hypothesis that medial thigh-based flaps had more donor-site complications than lateral thigh-based flaps.

The data gleaned from this retrospective study suggest that medial and lateral thigh flaps have similar donor-site morbidity. In our 12-year chart review of 352 patients, overall donor-site complication rates for medial and lateral flaps were 17.4% and 21.3%, respectively, a nonsignificant statistical difference. Furthermore, there were no significant differences in the rate of any particular complication between these 2 donor sites. While there was a significant difference of a mean of 1 additional postoperative office visit in lateral thigh flaps, there are myriad reasons for office visits, and the effect of donor-site issues on this is difficult to parse out.

In an effort to determine if harvesting a skin paddle affected donor-site morbidity, we also further divided lateral and medial thigh flaps into those with and without a skin paddle. Although the rate of dehiscence was higher in gracilis myocutaneous flaps and flaps closed with a skin graft at the donor site ($P = 0.009$), there were no significant differences between groups in overall complications.

To our knowledge, this is the first comparative study of medial and lateral thigh flap donor-site morbidity. Our overall complication rate in gracilis flaps was slightly higher than that reported in the literature. Deutinger et al[8] reviewed 38 gracilis muscle flap and 4 myocutaneous flap donor sites and noted a 12% rate of postoperative complications. Unfortunately, whether the complications occurred in muscle only or myocutaneous flaps was not

Table 3. Complication Rate Comparison between Flap Subtypes

	Medial Muscle Only (n = 127)	Medial with Skin (n = 26)	Lateral Muscle Only (n = 60)	Lateral with Skin (n = 123)	Skin Grafted (n = 16)	P
30-d readmission	24 (18.9%)	5 (19.2%)	17 (28.3%)	36 (29.3%)	3 (18.7%)	0.304
Hematoma	4 (3.1%)	1 (3.8%)	2 (3.3%)	4 (3.2)	0	0.966
Seroma	4 (3.1%)	2 (7.7%)	5 (8.3%)	6 (4.9%)	1 (6.2%)	0.63
Reoperation	2 (1.6%)	1 (3.8%)	5 (8.3%)	5 (4.0%)	1 (6.2%)	0.29
Infection	3 (2.3%)	1 (3.8%)	1 (1.7%)	3 (2.4%)	0	0.932
Lower extremity lymphedema	0	0	1 (1.7%)	1 (0.8%)	0	0.681
Dehiscence	13 (10.2%)	7 (25.9%)	7 (11.6%)	10 (8.1%)	5 (31.2%)	0.009
Any complication	19 (14.9%)	8 (30.8%)	14 (23.3%)	22 (17.9%)	6 (37.5%)	0.99
Time until drain removal	16.3	15	18.1	10.9	11.75	0.052
No. postoperative visits	3.35	3.14	2.29	4.66	6	<0.001

reported. Carr et al[7] noted a 9.6% rate of early complications at 104 gracilis flap donor sites. The most common complications were significant pain (4 patients) and wound infection (3 patients).[7] Our overall complication rate in gracilis flaps was 17.4%, of which most complications were dehiscence. Myocutaneous gracilis flaps had a 30.8% rate of complications, once again with dehiscence being the most common. These data suggest that harvesting a *skin paddle* medially does seem to result in more complications. Craggs et al evaluated donor-site morbidity after 49 transverse upper gracilis flap harvests and noted a wound healing complication at the donor site in 67% of flaps.[17] However, it is important to note that the myocutaneous gracilis flaps in the present study are not directly comparable with transverse upper gracilis flap donor sites, as all skin paddles in our series were longitudinal. Medial thigh muscle-only flap donor sites seem to have fewer wound healing complications. Harvesting skin and subcutaneous tissue in the medial thigh would necessarily disrupt the dense medial bundle of lymphatics of the thigh, perhaps resulting in more fluid buildup and a greater complication rate.[9]

Similar to medial thigh flaps, our reported donor complication rates for lateral thigh flaps were also somewhat higher than those in the literature. In their classic article describing 672 ALT flaps, Wei et al[13] described 4 donor-site hematomas (0.05%) and 10 donor-site infections (1.4%). Hanasono et al[5] performed a prospective study of ALT flap donor-site morbidity in 220 flaps. Twenty-four patients (11%) had a donor-site complication, most commonly seroma (11 patients, 5%).[5] A meta-analysis was performed of ALT donor-site morbidity in greater than 1,000 flaps across 42 studies. In this manuscript, the donor-site complications noted were wound breakdown and hypertrophic scar (4.8%), infection (2.2%), seroma (2.4%), and hematoma (0.7%).[18] In the literature, paresthesia and dysesthesia are common lateral thigh complications; however, rates of these complications are not routinely reported in our clinical notes and, therefore, cannot be addressed in the present study. Our overall complication rate for lateral thigh flaps was 21.3%, with the most common complication being dehiscence (11.2%). The difference in our reported complication rate and those of other studies is likely because of our broad definition of dehiscence. With the objective of this study being to comprehensively assess immediate complications in these flap types, we included any wound healing complication, even a small area of secondary healing, as a dehiscence, which likely contrasts with a more severe dehiscence definition utilized in many studies.[5,17,19] In a comparative study of ALT donor sites versus lateral arm and parascapular flap donor sites by Klinkenberg et al,[19] there were 4 dehiscences in the ALT group (25%), which agrees more closely with our data. However, with only 20 flaps included, it is difficult to draw conclusions about the rate of overall complications. Given the low rate of serious complications requiring a donor-site reoperation in our series of 352 flaps (1.9% and 5.6% for medial and lateral flaps, respectively), we feel that both flap donor sites are excellent options that are essentially interchangeable from a standpoint of donor-site morbidity.

Our univariate analysis of risk factors for a patient complication only determined that postoperative therapeutic anticoagulation was associated with increased complications. Interestingly, the number of hematomas was not significantly increased by anticoagulation. The most significant increase in complications in anticoagulated patients was in donor-site reoperation and infection. This is because subclinical hematomas may have resulted in eventual donor-site infections, or because patients who required anticoagulation were generally more ill (because of venous thrombosis or pre-existing cardiac conditions) predisposing them to more complications. We do not typically prescribe therapeutic anticoagulation for free flap patients for anastomotic thrombosis prevention.

As this study is a retrospective review, it has several drawbacks. Because our assessment of complications is drawn from a review of clinic and hospital notes and electronic medical record data, complications that were not expressly noted are missed. Due to this, we elected to err on the side of inclusion of any reference to a wound healing issue as a complication. Several other studies have noted a significant incidence of donor-site paresthesias with lateral thigh donor sites; however, this complication is not routinely assessed at our center, thereby prohibiting any commentary on its incidence here.[5,6,18,19] Analysis of donor-site esthetics, including pathologic scarring and pigmentation, was also not included in this study. Additionally, we do not routinely perform preoperative and postoperative strength testing of the lower extremity after thigh flap harvest. Ideally, a study of donor-site morbidity of thigh muscle flap donor sites would include strength testing. There have been several studies that evaluated functional morbidity after rectus femoris harvest and this has been found to be well tolerated and, if proper physical therapy performed, compensated completely by remaining musculature.[20,21] Although we are unaware of any studies performing formal strength testing after gracilis or vastus lateralis flap harvest, functional loss at these donor sites is reported to be minimal.[5,6,22] Finally, surgeons in this study chose flaps as per their clinical judgment. Although all surgeons participating in this study use both medial and lateral thigh-based flaps, the indications for performing these may have differed between surgeons. Furthermore, this study should not be utilized as a comparison of perforator versus nonperforator flaps, as the degree to which flaps were dissected as true perforator or chimeric flaps versus a simpler composite dissection was not captured in the study data.

CONCLUSIONS

Donor-site morbidity is similar in both lateral and medial thigh-based flap harvest. As both locations offer ease of dissection and reliable anatomy, they may be used interchangeably from one another with respect to donor-site complications. The inclusion of muscle in the flap from either donor site does not seem to increase complications, but the myocutaneous gracilis flap, or a skin grafted lateral thigh donor site, results in increased wound healing complications.

Mohammed S. Alghoul
Division of Plastic Surgery
Department of Surgery
Northwestern University Feinberg School of Medicine
675 N St. Clair Street
Suite 19-250
Chicago, IL, 60611
E-mail: malghoul@nm.org

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