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Examining Length of Hospital Stay after Microsurgical Breast Reconstruction: Evaluation in a Case-Control Study

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Background: While possessing numerous benefits, microsurgical breast reconstruction is associated with longer operative times and post-operative hospital length of stay compared to implant-based reconstruction. We therefore evaluate factors associated with increased length of stay (LOS) after microsurgical breast reconstruction with a case-control study design.

Methods: All patients undergoing immediate or delayed abdominally-based microsurgical breast reconstruction over a two-year time period were identified. Risk factors associated with LOS greater than or equal to 5 days were identified.

Results: A total of 116 patients undergoing immediate or delayed abdominally-based microsurgical breast reconstruction were identified. Of these, 86 (74.1%) had a LOS of 4 days or less (mean: 3.70 days) while 30 (25.9%) had a LOS of 5 days or greater (mean: 5.50 days).

With regards to patient demographics and intra-operative factors, patients with a LOS of 5 days or greater were significantly more likely to have diabetes mellitus ($p < 0.0001$), undergo bilateral reconstruction ($p = 0.0003$) and total mastectomy ($p < 0.0001$), and have a longer operative time ($p < 0.0001$) while significantly less likely to undergo post-operative radiation ($p = 0.0421$). Notably, there was no significant difference between the groups in terms of follow-up time, or time since breast reconstruction ($p = 0.0600$).

With regards to reconstructive complications, patients with LOS of 5 days or greater were significantly more likely to experience abdominal donor site abscess ($p < 0.0001$), breast hematoma ($p = 0.0186$), and return to the operating room for flap compromise ($p < 0.0001$).

Conclusions: Multiple patient-specific, intra-operative, and post-operative outcomes factors are associated with increased length of stay with immediate and delayed microsurgical breast reconstruction. (*Plast Reconstr Surg Glob Open* 2017;5:e1588; doi: 10.1097/GOX.0000000000001588; Published online 28 December 2017.)

INTRODUCTION

Postmastectomy breast reconstruction options include a variety of prosthetic and autologous techniques.¹⁻⁹ Although alloplastic reconstruction remains most common, microvascular autologous-based reconstruction has demonstrated good aesthetic results with high long-term patient satisfaction in a single-stage procedure.⁵⁻¹² While possessing numerous benefits, microsurgical breast re-

construction is associated with longer operative times and postoperative length of inpatient hospital stay compared with implant-based reconstruction.^{11,12}

Meanwhile, length of postoperative hospitalization is becoming an increasingly utilized surgical outcome metric.^{13,14} With regard to autologous breast reconstruction, increased length of hospital stay has unsurprisingly been linked to increasing health-care cost.¹⁵ Multiple studies have also evaluated the influence of specific interventions or enhanced recovery pathways on outcomes after autologous breast reconstruction, including length of hospital stay.¹⁶⁻¹⁸

Despite the focus on maximizing patient outcomes while minimizing hospital-based cost, there is a lack of evidence examining risk factors for increasing length of postoperative hospital stay after autologous breast reconstruction. Such information would benefit hospital systems and individual

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surgeons alike by identifying actionable factors that can be addressed to improve outcomes and refine risk stratification of patients presenting to discuss surgical options for post-mastectomy breast reconstruction. We therefore seek to elucidate factors associated with increased length of stay (LOS) after autologous breast reconstruction at a large, metropolitan center utilizing a case-control study design.

METHODS

All patients undergoing autologous microsurgical breast reconstruction utilizing an abdominal donor site at NYU Langone Medical Center with 6 primary plastic surgeons over a 2-year time period from 2015 to 2017 were identified. Length of inpatient hospital stay was calculated for all patients. By definition, the day of surgery was denoted as postoperative day 0; postoperative day 1 started on the morning following the day of surgery. Patients were distributed into 2 groups: those with a LOS greater than or equal to 5 days (120h) and those with a LOS of 4 days (96h) or less. Patient demographics, intraoperative variables, and overall and individual reconstructive outcomes were collected, analyzed, and compared for the 2 groups in a case-control study design.¹⁹ Risk factors associated with longer LOS were thus identified.

With regard to reconstructive complications, individual complications were divided into 3 main categories: abdominal donor-site complications, breast-related complications, and microsurgical complications. Delayed wound healing of the abdominal donor site was defined by any wound breakdown that was treated either with local wound care or debridement, whether in an office or operative setting. Cellulitis was considered any superficial infection of the breasts or abdomen that was treated with either oral or intravenous (IV) antibiotics. Major mastectomy flap necrosis was defined as that managed with operative or office debridement, whereas minor mastectomy flap necrosis was that managed with local wound care.

Descriptive statistics and measures of central tendency were used to describe absolute and mean results, respectively. Student's *t* tests were used to analyze binary data sets, whereas Chi-squared analysis was used to compare proportional responses. All statistical analysis was performed using GraphPad Software, Inc. (La Jolla, Calif.). *P* values of less than 0.05 were deemed significant.

POSTOPERATIVE MANAGEMENT

All patients were transferred to a surgical step-down unit for flap checks after initial monitoring in the postanesthesia care unit. Flap checks were performed by surface Doppler signals and clinical assessment every 1 hour for the first 24 hours, and subsequently every 2 hours and 4 hours on postoperative days 2 and 3, respectively. Anticoagulation was started the evening of surgery with aspirin 300 mg per rectum or 325 mg orally followed by 81 mg orally for 1 month. Patients were also placed on 40 mg of low weight molecular heparin subcutaneously daily for venous thromboembolism prophylaxis while in-house.

On postoperative day 1, patients were given a diet and encouraged to get out of bed to a chair. Foley catheters were subsequently removed once patients were able to sit

in a chair. IV fluids were stopped when patients were able to demonstrate adequate oral intake. On postoperative day 2, patients were encouraged to ambulate with physical therapy and were transferred to a regular room if flap checks, vital signs, and their overall clinical condition were stable. Subsequent progress and discharge were based on the patient's ability to independently ambulate, achieve adequate pain control with oral pain medications, and tolerate a regular diet, and their confidence in their ability to function at home with whatever assistance was available. All aspects of postoperative management and discharge parameters are extensively discussed with patients preoperatively.

Patients generally received as needed oral narcotic pain medications, which was supplemented with standing or as needed acetaminophen, standing ketorolac and/or ibuprofen if there was no concern for excess bleeding, and IV narcotic medication for breakthrough pain. In the earlier study period, patients were placed on patient-controlled analgesia pumps that were discontinued the first postoperative morning. All patients were also given 5 mg of Valium orally scheduled every 8 hours for muscle spasm relief. Patients received low-dose aspirin as a scheduled medication for its antiplatelet rather than analgesic effect.

RESULTS

A total of 116 patients undergoing immediate or delayed abdominally based microsurgical breast reconstruction were identified. Of these, 86 (74.1%) had a LOS of 4 days (96h) or less (mean: 3.70 d; range: 2–4 d), whereas 30 (25.9%) had a LOS of 5 days (120h) or greater (mean: 5.50 d; range: 5–8 d). There was a significant difference in LOS between the groups ($P < 0.0001$). Overall LOS for the entire cohort of patients was 4.16 days (range: 2–8) (Fig. 1).

With regard to patient demographics and intraoperative factors, patients with a LOS of 5 days or greater were significantly more likely to have diabetes mellitus ($P < 0.0001$), undergo bilateral reconstruction ($P = 0.0003$) and total mastectomy ($P < 0.0001$), and have a longer operative time ($P < 0.0001$). These patients were significantly less likely to undergo postoperative radiation ($P = 0.0421$). There were no significant differences between these 2 groups in terms of age ($P = 0.0714$), body mass index ($P = 0.4541$), smoking history ($P = 0.6829$), timing of reconstruction ($P = 0.4166$), double-attending cases ($P = 0.8329$), or transversus abdominis plane (TAP) block ($P = 0.2329$). Notably, there was no significant difference between the groups in terms of follow-up time or time since breast reconstruction ($P = 0.0600$) (Table 1).

With regard to reconstructive complications, there were equivalent rates of overall complications between patients with a LOS of 4 days or less and those with a LOS of 5 days or greater (47.7% vs 53.3%; $P = 0.5367$). Patients with LOS of 5 days or greater were significantly more likely to experience abdominal donor-site abscess ($P < 0.0001$), breast hematoma ($P = 0.0186$), and return to the operating room for flap compromise ($P < 0.0001$). Notably, there were no instances of complete flap loss as all cases in which a return to the operating room was required re-

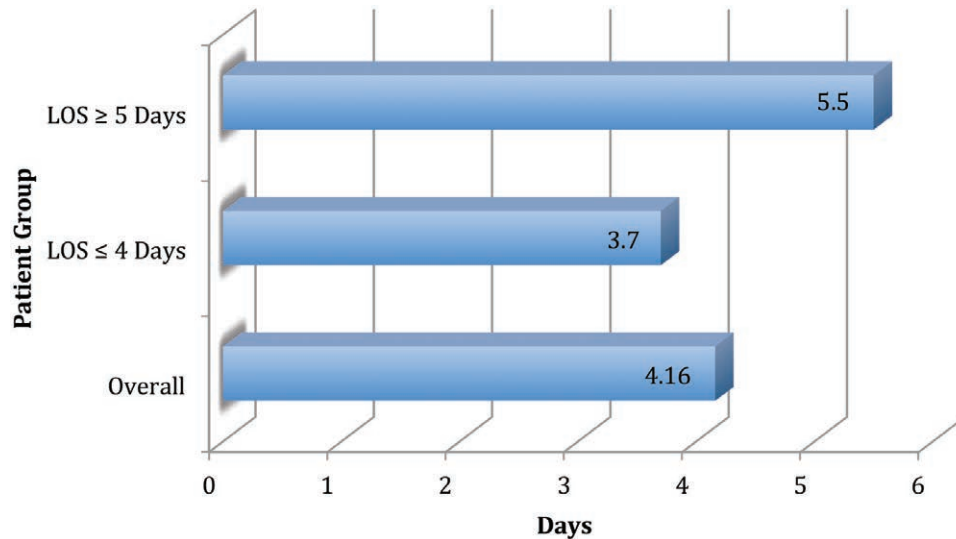


Fig. 1. Average postoperative length of inpatient hospital stay in overall patient group and in patients with LOS ≤4 days and ≥5 days.

Table 1. Impact of Patient Demographics and Intraoperative Variables on Length of Hospital Stay in Patients Undergoing Microsurgical Breast Reconstruction with Abdominally Based Flaps

	LOS ≤ 4 d (96h)	LOS ≥ 5 d (120h)	P
N	86	30	—
Age (y)	50.13	53.71	0.0714
BMI (kg/m ²)	27.98	28.83	0.4541
Diabetes mellitus	2 (2.3%)	4 (13.3%)	<0.0001
Smoking history	23 (26.7%)	9 (30.0%)	0.6829
Previous radiation	16 (18.6%)	3 (10.0%)	0.2261
Previous chemotherapy	22 (25.6%)	7 (23.3%)	0.7760
Mastectomy indication			0.1801
Therapeutic	86 (66.7%)	32 (58.2%)	
Prophylactic	43 (33.3%)	23 (41.8%)	
Mastectomy timing			0.4166
Immediate	71 (82.6%)	27 (90.0%)	
Delayed	13 (15.1%)	2 (6.7%)	
Immediate/delayed	2 (2.3%)	1 (3.3%)	
Laterality			0.0003
Bilateral	43 (50.0%)	25 (83.3%)	
Unilateral	43 (50.0%)	5 (16.7%)	
Mastectomy type			<0.0001
Total	39 (30.2%)	30 (54.5%)	
SSM	44 (34.1%)	6 (10.9%)	
NSM	44 (34.1%)	19 (34.5%)	
Radical	2 (1.6%)	0 (0.0%)	
Abdominal flap			0.4809
DIEP	120 (93.0%)	53 (96.4%)	
msTRAM	6 (4.7%)	2 (3.6%)	
SIEA	3 (2.3%)	0 (0.0%)	
Double-attending case	50 (58.1%)	18 (60.0%)	0.8329
TAP block	35 (40.7%)	9 (30.0%)	0.2329
Average OR time (h:min)	7:45	9:34	<0.0001
Average mastectomy weight (g)	675.04	729.16	0.4078
Postoperative radiation	15 (17.4%)	1 (3.3%)	0.0421
Postoperative chemotherapy	21 (24.4%)	8 (26.7%)	0.7725
Average LOS (d)	3.70	5.50	<0.0001
Follow-up (mo)	11.95	14.58	0.0600

BMI, body mass index; DIEP, deep inferior epigastric perforator flap; msTRAM, muscle-sparing transverse rectus abdominis myocutaneous flap; NSM, nipple-sparing mastectomy; OR, operating room; SIEA, superficial inferior epigastric artery flap; SSM, skin-sparing mastectomy. Bold values represent those that reached statistical significance

sulted in flap salvage. Inherently, there was no significant difference between the groups in this regard ($P = 1.000$) (Table 2). No patients returned to the operating room for any reason other than flap compromise, such as for debridement of mastectomy flap necrosis.

DISCUSSION

Microsurgical autologous breast reconstruction has numerous advantages over implant-based techniques, which remain the most commonly employed.⁵ These advantages include single-stage reconstruction, good aesthetic results,

Table 2. Impact of Reconstructive Outcomes on Length of Hospital Stay in Patients Undergoing Microsurgical Breast Reconstruction with Abdominally Based Flaps

	LOS ≤ 4 d (96 h)	LOS ≥ 5 d (120h)	P
N	86	30	—
Overall complications	41 (47.7%)	16 (53.3%)	0.5367
Abdominal donor-site complications			
Delayed wound healing	20 (23.3%)	11 (36.7%)	0.0833
Cellulitis	3 (3.5%)	0 (0.0%)	0.2969
Seroma	2 (2.3%)	1 (3.3%)	0.7058
Abscess	0 (0.0%)	1 (3.3%)	<0.0001
Breast-based complications			
Major mastectomy flap necrosis	9 (7.0%)	7 (12.7%)	0.0509
Minor mastectomy flap necrosis	5 (3.9%)	0 (0.0%)	0.1352
Cellulitis	1 (0.8%)	0 (0.0%)	0.5054
Hematoma	1 (0.8%)	3 (5.5%)	0.0186
Seroma	2 (1.6%)	0 (0.0%)	0.3443
Fat necrosis	7 (5.4%)	3 (5.5%)	0.9707
Microsurgical complications			
Return to OR	0 (0.0%)	5 (16.7%)	<0.0001
Flap loss	0 (0.0%)	0 (0.0%)	1.0000
Partial flap necrosis	0 (0.0%)	1 (1.8%)	0.1241

OR, operating room.

Bold values represent those that reached statistical significance

especially in unilateral reconstructions, and improved patient satisfaction compared with alloplastic reconstruction.^{5–12,20} Despite these benefits, autologous reconstruction is also associated with longer operative times and postoperative length of inpatient hospital stay.^{11,12} Longer postoperative hospital stays with autologous breast reconstruction have further been linked to greater initial health-care cost.^{11,12,15}

In the current health-care climate, multiple metrics have been evaluated in an effort to improve patient outcomes in a most cost-efficient manner.^{13,14} Postsurgical length of inpatient hospital stay has become a commonly utilized metric in this regard.^{13,14,16–18} The rise in implementation of enhanced recovery pathways after autologous breast reconstruction has mirrored the effort to reduce postoperative LOS and associated costs.^{13,14,16–19,21} For instance, Afonso et al. demonstrated significantly reduced length of hospital stay after autologous breast reconstruction with implementation of an enhanced recovery pathway comprised of reducing opioid-centered pain management, regional abdominal blocks, and goal-directed fluid therapy, among other changes.¹⁷

Although these studies have rightfully examined methods to reduce hospital LOS after autologous breast reconstruction, system- and patient-specific risk factors for increased LOS remain to be elucidated. We therefore sought to identify such risk factors in patients undergoing autologous breast reconstruction using an abdominal donor site, which remains the most frequently utilized.^{22,23} Further, all cases were performed at a large, metropolitan hospital center with a high microsurgical volume. Therefore, surgeon and care team familiarity and experience in managing patients undergoing microsurgical breast reconstruction were constant and expectantly high throughout the study period.

Postoperative length of inpatient hospital stay for the overall cohort of 116 patients was 4.16 days. This compares very favorably with the literature as it is nearly equivalent to the LOS demonstrated after implementation of an enhanced recovery pathway for abdominally based autologous

breast reconstruction in 1 recent study from a large cancer center.¹⁷ Given this natural inflection point, the groups were then divided into those with a LOS ≤4 days (96 h) and greater than 4 days (≥5 d; 120 h). This case-control study design is advantageous as it is particularly well suited to illuminate various etiologic factors contributing to longer LOS.¹⁹

Diabetes mellitus was identified as a patient-specific factor increasing length of hospital stay after autologous breast reconstruction. This can be expected as diabetes increases overall risk of wound healing issues, may complicate postoperative medical care, and may be associated with additional comorbidities that can complicate care and delay patient discharge. Wound complications due to diabetes mellitus tend to be subacute or chronic issues. However, patients with diabetes have been shown to be at greater risk for acute wound complications as well.²⁴ Although these may not lead to a need for immediate reoperation, they can delay patient readiness for discharge. Interestingly, patients with longer postoperative LOS were also identified to have significantly less postoperative radiation. The etiology of this finding is unclear and observational, although it is noted that there was a nonsignificant trend toward more prophylactic mastectomies in the shorter LOS group. Prior radiation was not identified as a risk factor for greater LOS. Importantly, body mass index, which has been identified as a risk factor for increased pain after breast surgery, did not affect postoperative LOS.²⁵ This may be due to the finding that the average patient in both groups was classified as overweight according to body mass index (>25 kg/m²). The independent effect of body mass index on LOS after microsurgical breast reconstruction remains to be defined.

In examining operative factors for increasing postoperative LOS, bilateral reconstruction, total mastectomy, and increased operative time were identified as risk factors. All of these factors implicate more technically challenging and involved procedures, which may be associated with greater postoperative pain and complexity of care, thus leading to longer postoperative stays.²⁶ Notable fac-

tors that were not found to increase LOS included timing of reconstruction (immediate vs delayed) and amount of muscle taken with the abdominal flap. Taken overall, the oncologic portion of an immediate breast reconstruction procedure seems to influence LOS less than the reconstructive portion, as may be expected. Further investigation may be required to further delineate the unique attributes of patient subsets undergoing immediate or delayed breast reconstruction as related to postoperative outcomes. However, given the results discussed earlier, the type of mastectomy performed in patients undergoing immediate breast reconstruction does seem to influence the LOS metric.

Interestingly, the utilization of regional TAP blocks was not found to be more likely in the group with shorter LOS. As a component of enhanced recovery pathways, TAP blocks have been shown to help reduce LOS.¹⁷ However, the independent effects of regional blocks on postoperative metrics after abdominally based autologous breast reconstruction remain to be completely evaluated. Given the beneficial effects of TAP blocks in reducing acute postoperative pain, we have continued to utilize ultrasound guided TAP blocks in this patient population.²¹

Overall complications were not found to influence LOS. Only abdominal donor-site abscess, breast hematoma (both operative and nonoperative), and return to operating room for flap compromise were identified as risk factors in patients with increased LOS. Hematoma and return to operating room are acute complications, which can be expected to portend a more complicated hospital stay. Abdominal donor-site abscess is a subacute complication that would not necessarily be expected to increase immediate postoperative LOS. However, this complication occurred in a single patient in the cohort with a greater LOS. Additionally, the same patient also experienced a breast hematoma and subsequent return to the operating room for impending venous compromise, likely contributing to this correlation.

Lastly, some patients may elect to stay an additional hospital day despite otherwise meeting discharge criteria. Preoperative counseling is critical to set objective discharge parameters so that patients may be aware of when discharge may be expected and to mitigate these medically unnecessary additional hospital days. Unfortunately, these factors are difficult to measure. However, the influence of preoperative patient counseling and expectation setting cannot be overstated as surgeons work to minimize hospital cost and LOS while simultaneously improving patient outcomes.

Wound healing complications and infections of the abdominal donor site and breast did not influence immediate postoperative LOS. It is notable that there were no flap failures and loss of reconstructions in the overall patient cohort. Five patients, all in the group with a longer LOS, required return to the operating room for flap compromise. However, all flaps were salvaged. Further, despite this deferential in flap compromise, rates of fat necrosis were low ($\leq 5.5\%$) and equivalent between the 2 groups.

The findings of this study may be utilized on patient-, surgeon-, and hospital-system levels. With this informa-

tion, plastic surgeons can more accurately counsel patients preoperatively both in regard to their expected outcomes and to emphasize expected discharge parameters. Postoperative metrics, including LOS, may thus further be optimized. Surgeons may also be better able to direct patients toward the most appropriate breast reconstruction modality in accordance with each patient's individualized preferences. At a hospital-system level, these findings may better inform administrators with regard to expected postoperative recovery periods for patients undergoing autologous breast reconstruction. As higher risk patients are identified, specific resources may be allocated toward enhancing and optimizing their recovery in a cost-effective manner, especially in cases of bundled reimbursement.

Limitations of this study include its retrospective nature and limited sample size, and that outcomes, such as mastectomy flap necrosis, were defined by intervention and thus influenced by surgeon preference in management. Follow-up time was approximately 1 year or greater in each group. This is sufficient follow-up to identify acute and subacute outcomes expected to influence immediate postoperative LOS. Moreover, follow-up time was equivalent between the 2 groups, confirming that the findings herein are not a result of greater capture in 1 group. Multi-institutional collaboration to compare factors related to LOS after autologous breast reconstruction as a future direction of research would strengthen the findings discussed herein. Lastly, this case-control study design may associate factors with increased LOS; however, future research is warranted to further elucidate and delineate these associations.

In conclusion, multiple patient-specific, intraoperative, and postoperative factors are associated with increased LOS in immediate and delayed microsurgical breast reconstruction. With this information, expected norms in postoperative outcome metrics and guidelines to modify pre-, intra-, and postoperative protocols in patients undergoing autologous breast reconstruction can be established. Further, risk stratification and establishment of patient expectations by surgeons and patient care teams may be improved. The findings herein may therefore benefit hospital systems, plastic surgeons, and patients alike.

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