Abdominal Wall Stability and Flap Complications after Deep Inferior Epigastric Perforator (DIEP) Flap Breast Reconstruction: Does BMI make a Difference?

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Background

Autologous breast reconstruction has evolved considerably throughout the years. Since the original description of pedicled TRAM flaps, abdominal-based breast reconstruction has been able to achieve reproducible and increasingly reliable aesthetic results. However, with sacrifice of the underlying rectus muscle and fascia, abdominal wall laxity and hernia formation was quickly identified as a considerable limitation of pedicled TRAMs. Consequently, due to significant donor site morbidity, pedicled TRAMs have been considered contraindicated in high-risk populations, such as patients with obesity.

In an attempt to decrease donor-site morbidity while maintaining flap reliability, free TRAM flaps were developed enabling limited fascial and rectus muscle resection. Previous studies comparing pedicled versus free TRAMs have verified improved abdominal wall stability with limited muscle and fascial resection. Relative muscle and fascial sparing made possible by free TRAM flaps have, nonetheless, been unable to overcome the inherent predisposition for abdominal wall morbidity associated with obesity.

With elimination of any fascial resection and rectus muscle harvest, deep inferior epigastric perforator (DIEP) flaps promise improved abdominal wall stability. Previous studies have documented improved abdominal wall stability among patients following DIEP flap breast reconstruction compared to free TRAMs. On the other hand, due to the delicate dissection required for DIEP flap elevation from surrounding muscle and overlying fascia, concerns have been raised regarding DIEP flap reliability. Furthermore, previous studies have identified obesity as an important factor decreasing flap reliability following free and pedicled TRAMs. Ultimately, the effects of obesity on flap and donor-site morbidity following DIEP flap breast reconstruction remain ill-defined.

Objective

Increasing body mass index (BMI) is associated with poor outcomes in breast reconstruction using traditional techniques. The current study aims at defining complications with increasing BMI among patients undergoing DIEP flap breast reconstruction.

Materials & Methods

A retrospective chart review was conducted among consecutive patients that underwent DIEP flap breast reconstruction from January 2006 to March 2008. Six hundred thirty nine DIEP flaps were performed on 418 patients by a single group practice (P.R.M.A.). Demographic data, medical co-morbidities, active tobacco use, oncologic history, and adjuvant therapy were collected pre-operatively. Active tobacco use was defined as usage of tobacco products within 6 weeks of reconstruction. In addition, the number of previous abdominal surgeries, open and/or laparoscopic, was collected.

Pre-operative BMI used to stratify patients into five groups: normal weight (≤ 24.9), overweight (25-29.9), obese (30-34.9), severe obesity (35-39.9), and morbid obesity (≥ 40). DIEP flap reconstruction was performed either in immediate or delayed fashion by two board-certified plastic surgeons with extensive microsurgical experience working simultaneously. Arterial and venous flap anastomoses were hand-sewn to internal mammary vessels using standard microsurgical technique. Intraoperative variables including number of perforators used, ischemia time, and overall reconstruction time were collected. The anterior rectus fascia was closed primarily after flap harvest. Length of hospital stay and time of follow-up was recorded in days.

Primary outcomes were defined as post-operative donor-site morbidity and flap complications. For both flap and donor-site soft tissue infections, further stratification into mild, moderate, and severe infections was performed in order to better define the degree of infectious complications. Mild infections were defined as clinically significant erythema, warmth, and induration requiring outpatient antibiotics. Moderate infections were defined as infections requiring debridement and wound packing in an ambulatory setting or use of parenteral antibiotics. Severe infections were defined as those requiring formal operative debridement. Similarly, for both flap and donor-sites, delayed wound healing was further stratified into mild, moderate and severe. Mild delayed wound healing was defined as minor wound dehiscence requiring local therapies including wound packing. Moderate delayed wound healing was defined as wound dehiscence requiring V.A.C.® therapy. Severe delayed wound healing complications were defined as extensive wound dehiscence requiring operative intervention. Recorded variables and incidence of primary outcomes were compared between BMI groups and analyzed for statistical differences.

Associations involving categorical variables were assessed using Pearson's Chi-square test or Fishers Exact Test, as appropriate. The Kruskal-Wallis Test was used to assess associations involving continuously distributed variables. Patients having bilateral reconstruction could contribute to more than one complication outcome category if present. Therefore, associations involving flap complications were assessed using a logistic regression model with binary response that accounted for correlation introduced by bilateral reconstructions. Logistic regression with forward selection was used to assess associations between potentially important covariates and the most prevalent complication outcomes observed. All statistical comparisons were performed using a significance level of 5% and SAS 9.2 (SAS Institute, Cary, North Carolina).

Results

Table 1. Study Population Stratified by Body Mass Index

Variable	N(%)
Body Mass Index (BMI)	
Normal (≤24.9)	100(23.9)
Overweight (25-29.9)	153(36.6)
Obese (30-34.9)	113(27)
Severely Obese (35-39.9)	45(10.8)
Morbidly Obese (≥40)	7(1.7)

Table 2. Percent Reconstruction Timing, Laterality, Adjuvant Therapy, and Cancer Recurrence by BMI

		Normal (%)	Overweight (%)	Obese (%)	Severely Obese (%)	Morbidly Obese (%)	P-value
Reconstruction							0.68
	Immediate	110(78)	184(77)	146(80.7)	48(70.6)	7(70)	
	Delayed	31(22)	55(23)	35(19.3)	20(29.4)	3(30)	
Laterality							0.06
	Unilat	59(59)	67(43.8)	45(39.8)	22(48.9)	4(57.1)	
	Bilat	41(41)	86(56.2)	68(60.2)	23(51.1)	3(42.9)	
XRT							
	Pre-op	29(29.3)	42(27.6)	32(28.6)	13(28.9)	2(28.6)	1
	Post-op	5(5.1)	9(5.9)	4(3.6)	2(4.4)	1(14.3)	0.59
Chemo							
	Pre-op	44(44.9)	65(43)	47(42)	14(31.1)	2(28.6)	0.56
	Post-op	32(32.7)	55(36.4)	40(35.7)	10(22.2)	4(57.1)	0.27
Cancer Recurrence		3(3)	1(0.7)	1(0.9)	0(0)	0(0)	0.46

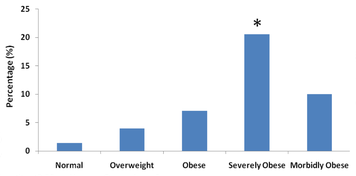
Table 3. Incidence of Flap Complications by BMI

	Normal (n=141)	Overweight (n=239)	Obese (n=180)	Severely Obese (n=68)	Morbidly Obese (n=10)	P-value
Flap Infection						
Overall	4(2.9)	12(5.3)	13(7.6)	4(5.9)	0(0)	0.41
Mild	3(2.2)	6(2.7)	6(3.5)	1(1.5)	0(0)	0.74
Moderate	1(0.7)	5(2.2)	6(3.5)	3(4.4)	0(0)	0.17
Severe	0(0)	1(0.4)	1(0.6)	0(0)	0(0)	N/A
Flap DWH						
Overall	2(1.4)	9(4)	12(7.1)	14(20.6)	1(10)	0.0014
Mild	2(1.4)	8(3.6)	12(7.1)	13(19.1)	1(10)	0.003
Moderate	0(0)	1(0.4)	0(0)	0(0)	0(0)	N/A
Severe	0(0)	0(0)	0(0)	1(1.5)	0(0)	N/A
Perfusion Comp						0.85
Thrombosis	2(1.4)	1(0.4)	1(0.6)	0(0)	0(0)	
Failure	0(0)	3(1.3)	3(1.7)	0(0)	0(0)	
Acute Hematoma	5(3.6)	3(1.3)	4(2.3)	0(0)	0(0)	0.39
Fat Necrosis	17(12.4)	22(9.9)	17(10)	7(10.3)	0(0)	0.95
Subacute Hematoma	5(3.6)	6(2.7)	2(1.2)	0(0)	0(0)	0.42
Seroma	1(0.7)	2(0.9)	1(0.6)	1(1.5)	0(0)	0.42
Total	33(23.4)	49(20.5)	45(24.9)	24(35.3)	1(10)	0.23

Table 4. Incidence of Donor-site Complications by BMI

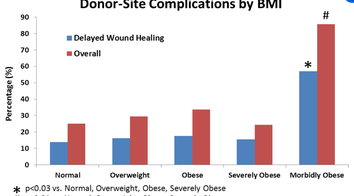
	Normal (%)	Overweight (%)	Obese (%)	Severely Obese (%)	Morbidly Obese (%)	P-value
Donor Site Infection						
Overall	7(7)	8(6.5)	8(7.1)	2(4.4)	3(42.9)	0.08
Mild	3(3)	6(3.9)	6(5.3)	2(4.4)	2(28.6)	0.121
Moderate	4(4)	2(1.3)	2(1.8)	0(0)	1(14.3)	0.132
Severe	0(0)	2(1.3)	0(0)	0(0)	0(0)	0.626
Delayed Wound Healing						
Overall	14(14)	25(16.3)	20(17.7)	7(15.6)	4(57.1)	0.03
Mild	12(12)	20(13.1)	17(15)	7(15.6)	3(42.9)	0.281
Moderate	2(2)	5(3.3)	0(0)	0(0)	1(14.3)	0.049
Severe	0(0)	0(0)	3(2.7)	0(0)	0(0)	0.132
Acute Hematoma	0(0)	0(0)	0(0)	0(0)	0(0)	1
Seroma	4(4)	10(6.5)	11(9.7)	2(4.4)	0(0)	0.53
Subacute Hematoma	0(0)	0(0)	0(0)	0(0)	0(0)	1
Abdominal Bulge	1(1)	0(0)	0(0)	0(0)	0(0)	0.36
Hernia	1(1)	2(1.3)	3(2.7)	0(0)	0(0)	0.722
Total	25(25)	45(29.4)	38(33.6)	11(24.4)	6(85.7)	0.02

Flap Delayed Wound Healing by BMI



∗ p≤0.05 vs. Normal, Overweight, Obese

Donor-Site Complications by BMI



∗ p<0.03 vs. Normal, Overweight, Obese, Severely Obese
# p<0.01 vs. Normal, Overweight, Obese, Severely Obese

Conclusion

Deep inferior epigastric perforator flaps represents a significant advance in the evolution of abdominal-based breast reconstruction. Potential abdominal donor-site morbidity and flap reliability play a significant role in determining reconstructive options for high risk patients such as those with previous abdominal surgery or obesity. The current findings demonstrate excellent reliability of DIEP flaps in obese patients. In addition, by eliminating sacrifice of rectus musculature and maintaining the integrity of the overlying fascia, DIEP flaps effectively maintain abdominal wall stability even in obese populations. Consequently, not only are DIEP flaps safe in obese populations, but in fact may be the preferred method of abdominal-based breast reconstruction in patients with a BMI less than 40.

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