Long term outcomes of latissimus dorsi flap breast reconstructions. A single centre observational cohort study with up to 12 years of follow up

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Summary.

Introduction:

The Latissimus Dorsi Myocutaneous Flap (LDMF) is used in post-mastectomy reconstruction. This study has evaluated long-term (up to 12 years) surgical and patient reported outcomes from LDMF procedures.

Method:

Retrospective analysis of consecutive LDMF procedures in two UK hospitals, performed between 2006-2016. Case notes were reviewed for indications and outcomes. Patients were sent the BREAST-Q® survey by post. Outcomes, including surgical adverse events, revision and implant loss rates, were correlated with patient risk factors.

Results:

A BREAST-Q was posted to 199/248 LDMF patients in 2018, (excluding 49 due to death, reduced cognitive function, incorrect coding) of whom 77 responded (38.7%). In 188 cases (representing 208 LDMFs) surgical outcomes were assessable. Median time since LDMF surgery was 7 years (range 2-12). Rates of acute implant loss were 9/139 (6.4%), flap necrosis 7/208 (3.4%), shoulder stiffness 4/208 (1.9%), chronic pain 24/208 (11.5%) and unplanned revision surgery 13/208 (7%).

Median satisfaction levels were high with 78% satisfied with treatment outcomes, 65% satisfied with their breasts, 71% satisfied psychosocially and 75% satisfied with their chest. Receipt of radiotherapy was not associated with a higher risk of flap necrosis or capsule formation.

Conclusion:

Long-term follow-up of a large cohort of LDMF reconstruction patients show relatively low levels of adverse events and unplanned revision surgery and high patient satisfaction, demonstrating how temporally robust the technique is. With the rise in popularity of acellular dermal matrix (ADM) reconstructions, the LDMF has relatively fallen out of favour but its potential in primary and delayed reconstruction is demonstrated.

250/250

Key words (4-6): Breast reconstruction, latissimus dorsi flap, patient reported outcomes.

Introduction.

Post-mastectomy reconstruction rates have increased markedly in the last 20 years[1]. The type of techniques utilised for reconstruction has changed with time. Early reconstructions involved placing implants in a submuscular or subcutaneous position. Use in the subcutaneous location was associated with high rates of implant loss and visible wrinkling but a better breast shape and contour[2,3]. Use of the submuscular location, whilst less likely to result in implant loss, gives an inferior breast shape with a lack of lower pole projection[2]. For this reason many women with larger or more ptotic breasts had a latissimus dorsi flap to provide improved implant coverage and breast contour. The advent of acellular dermal matrices (ADM) and synthetic meshes has been rapidly adopted[4,5] in implant reconstruction, facilitating larger size reconstructions and giving a more natural tear-drop shape. More recently, interest in subcutaneous implant placement has been renewed, supported by prepectoral implant coverage with ADMs to reduce some of the previously noted limitations of subcutaneous implant placement. In contrast to the LDMF, the early morbidity of surgery is lower[6]. However, subsequent series have shown that ADMs may be associated with higher rates of early implant loss and, in the longer term, due to the thin layer of soft tissue coverage over the implant, cosmesis may be poor with thinning of skin flaps[3,7,8]. The LDMF has also been supplanted by the increased availability of autologous free flaps such as DIEPs and TUGs, and less commonly by use of the thoracodorsal artery perforator flap (TDAP) which may be able to provide sufficient skin and volume for post-mastectomy reconstruction in some women[9,10].

Another key issue is the impact of post-mastectomy radiotherapy. Implant based reconstruction are associated with a three-fold higher rate of complications including

capsular contracture, implant extrusion and fibrosis. A large metanalysis of 20 retrospective studies[11] showed an increase in almost all complications when radiotherapy was used including overall reconstruction failure (relative risk (RR):2.58, confidence interval (CI): 1.86–3.57) and total complications (RR:1.89, CI: 1.57–2.28) in irradiated patients. The risk of capsular contracture was also higher (RR:3.32, CI: 1.36–8.13), and the risk of infection, flap necrosis and seroma were significantly increased. Use of ADMs was not protective. In contrast, use of an LDMF was more robust to the impact of radiotherapy in comparative series with rates of reconstructive failure for implant + autologous tissue of 6.9% compared with 33.7% for implant-only reconstruction[11]. Another series found a four-fold increased rate of implant loss for implant only versus LDMF (RR:4.33, CI: 1.94-9.68)[12]. Other series have shown similar findings[13].

A recent UK national audit (Getting it Right First Time[14]) has highlighted the need for multiple surgeries for breast reconstruction patients with their associated costs and morbidities[1,15].

The objective of this observational study of consecutive LDMF reconstructions was to determine rates of long-term complications, reoperation rates and late patient-reported outcomes.

Methods.

A retrospective, consecutive series of LDMF post-mastectomy breast reconstruction cases was derived from operating lists between 2006-2016 at 2 UK hospitals. These hospitals provide oncoplastic and reconstructive surgery services either directly on site or via referral to neighbouring plastic surgery units (for free flaps). Case notes were reviewed to extract data using a standardised proforma. Data included: primary tumour characteristics (stage, grade, biological subtype), whether reconstruction surgery was immediate or delayed, the indication for surgery, use of implants, expanders or fully autologous and surgical risk factors (diabetes, smoking, radiotherapy). Details of surgical outcomes were collected including rates of implant loss, reason for loss, wound infection, haematoma, planned and unplanned revision surgery. All procedures were performed by fully trained consultant surgeons using standard techniques which have remained unchanged over the review period. All surgeons used closed suction drains for the back wounds and quilting was used for some cases to reduce seroma formation. Flap denervation (to reduce animation) and division of flap insertion was not performed routinely by any surgeon. Complications were categorised for severity using the Common Terminology Criteria for Adverse Events[16]. Patients were sent a postal BREAST-Q questionnaire to assess their perceptions of longer-term outcomes[17]. For analysis of patients' demographics, BREAST-Q outcomes and risk factors, those undergoing bilateral LDMF in the same sitting, were analysed as single cases. For analysis of surgical adverse events, each LDMF procedure was analysed separately. The article complies with the STROBE statement for the reporting of observational studies[18]. Use of the BREAST-Q Questionnaire, authored by Drs. Klassen, Pusic and Cano, was made under license from Memorial Sloan Kettering Cancer Center, New York, USA".

Statistical analysis.

Descriptive statistics report means and standard deviations or medians plus ranges. Univariate analysis of the association of risk factors and outcomes was performed using Chi squared or Fisher's exact test. Analysis of the BREAST-Q score was performed according to the published protocol[17]. All analyses were performed using IBM SPSS (v25). A p-value <0.05 was considered statistically significant.

Results

Initial case review yielded 248 consecutive patients coded as LDMF reconstructions performed between January 2006 and December 2016. Of these, 208 LDMF reconstructions (representing 188 patients of whom 20 were bilateral cases), were included in the surgical review after excluding cases of incorrect coding or those with inadequate data in the case notes (Figure 1). For the BREAST-Q analysis cases were excluded if they were incorrectly coded, deceased or lacked cognitive capacity, leaving 199 LDMF cases to whom the BREAST-Q questionnaire was posted (Figure 1).

Patient demographics are shown in Table 1. Median age was 49 (range 25-71). The majority of cases were LDMF plus implant reconstructions. The majority had mastectomy for invasive cancer (N=177, 85%) with fewer for ductal carcinoma in situ (DCIS, N=20, 7%) or risk reduction (N=7, 3%). Median follow up was 7 years (range 2-12). Eleven percent of women were smokers and 24% ex-smokers. Body mass index was normal in 48% and over 30 in 15%. Radiotherapy was given to 51% of cases.

Table 1. Table showing patient characteristics

Characteristic	**N (%)**
Total number of patients	188 (100)
Total number of LDMFs	208
Patients with Unilateral LDMF	168/188 (90)

Patients with Bilateral LDMF	20/188 (10.6)
Median Age (Years)	49 (25-71)
Median follow-up duration (Years)	7 (2-12)
Type of LDMF	
Autologous only (extended LDMF)	68/208 (32.7)
Plus implant	139/208 (66.8)
Missing	1/208 (0.5)
Timing of LDMF	
Immediate	120/208 (57.8)
Delayed	88/208 (42.3)
Indication for Mastectomy	
Invasive cancer	177/208 (85.1)
Ductal carcinoma in situ	20/208 (9.6)
Risk Reduction	7/208 (3.4)
Missing	4/208 (2)
Axillary surgery	
No axillary surgery[1]	42/208 (20.2)
Sentinel Node Biopsy	37/208 (17.8)

Axillary node clearance	129/208 (62)
Risk Factors per LDMF procedure[2]	
Comorbidities	
Diabetes	4/208 (1.9)
Hypertension	13/208 (6.2)
Radiotherapy (RT)	106/208 (50.9)
RT Pre-LDMF	35 (17)
RT Post-LDMF	71 (34)
No RT/RT not indicated	87 (42)
Data unavailable	15 (7)
Median BMI (Range)	26 (17-42.5)
Smoker	23/208 (11)

1.For example in risk reduction and delayed reconstruction cases

2.Measured per flap as some bilateral cases were not done at the same time but consecutively

Complications.

Minor wound complications included seroma (120/208; 58%) (which is a similar rate to other reported series[19]) and minor wound infections (19/208; 9%). All patients had insertion of closed suction drains and quilting was performed by several surgeons to reduce the rate of seroma formation[20]. There were 27/208 (13%) wound infections of which 8 (3.4%) required inpatient care or surgical intervention. There was one respiratory tract

infection, but no other systemic complications. Acute implant loss (9/139, 6.5%) was due to wound infection (6/9), flap necrosis (2/9) and haematoma (1/9) (Table 2). There were no cases of implant extrusion or exposure. There were no cases requiring intervention for flap animation or spasm in this series.

There was a higher wound infection rate in the immediate group compared with the delayed group (21/120 (17.5%) versus 6/88 (6.8%); p=0.024). This group also had more clinician reported patient dissatisfaction compared to the delayed group (16/69 (23%) versus 4/53 (7.5%); *P=0.021*) (Table 3). There were no significant associations between patient age, smoking status, obesity, diabetes, radiotherapy or chemotherapy with acute wound complications.

Chest wall radiotherapy was not associated with a higher rate of flap necrosis compared to no radiotherapy (Table 3). There was no significant association between radiotherapy and capsular contracture, nor with the number of corrective procedures required (Table 3).

Further Surgeries

Addition surgical procedures were performed in 119/208 cases (57%) (median number 2; range 1-12). No further surgery was required in 80 patients (41%) (Table 2)

Of these additional procedures, 119 operations in 61 patients were planned elective procedures including nipple reconstruction, lipomodelling, exchange of implant and filler port removal, contralateral uplift and/or reduction procedures in 26 (12.5%) and four cases

had contralateral augmentation.

A small number of women underwent multiple procedures (13, 7%) with a minimum of five and a maximum of 12 procedures. Of these, seven had implant problems; capsular contracture (Baker 4), chronic seroma and infection. The remainder had multiple minor corrections for symmetry and contour in the form of scar correction and lipomodelling. Nine required implant removal for capsular contracture or chronic seroma (see Table 2).

Table 2. Complications of surgery and further surgeries

Acute complications (within 3 months of surgery)	**Number (%)**
Total wound infections	27/208 (13)
Major wound infections	8/208 (3.8)
Minor wound infections	19/208 (9)
Haemorrhage/haematoma	4/208(2)
Flap necrosis	7/208 (3.4)
Acute implant loss if implant used	9/139 (6.5%)
Re-admission within 30 days of surgery	10/208 (4.8)
Seroma requiring aspiration	120/208 (58) median 2 (range 0-11)
Long term complications	

Scar related issues	30/208 (14)
Trimming of redundant skin	28/208 (13)
Chronic hematoma	1/208 (0.5)
Delayed wound healing	1/208 (0.5)
Chronic pain[1]	24/208 (11.5)
Shoulder stiffness	4/208 (1.9)
Arm weakness	9/208 (4.3)
Chronic seroma	11/208 (5.3)
Capsule formation, any grade (where implants used)	14/139 (10)
Baker grade III/IV	7/139 (5)
Implant rupture	3/139 (2)
Implant migration	2/139 (1.4)
Median number of revision surgeries (range)[2]	**2 (1-12)**
None	80/208 (38)
Number of patients having further planned procedures[3]	**61/188 (32)**

Nipple reconstruction per LDMF	39/208(19)
Lipomodelling	22/208 (11)
Expander exchange where implants used	17/139 (12)
Symmetrisation of unilateral LDMFs	30/168 (18)
Number of patients having unplanned revision surgery[3]	**13/188 (7)**
Capsulectomy	9/139 (6.4)
Capsulorrhaphy	0/139 (0)
Implant exchange	3/139 (2)
Lipomodelling/scar revision per LDMF	6/208 (2.8)
Explantation	6/139 (4.3)
Other	3/208 (1)
Length of hospital stay	
0-5 days	160/208 (77)
6-10 days	44/208 (21)
Missing	4/208 (2%)

1- Chronic pain included scar related pain, post-operative neuralgia, LD muscle spasm, shoulder and back pain.

2- Surgery for cancer recurrence and other procedures that were not for amendment of reconstruction were excluded in the table.

3 - Some cases had a combination of up to 3 procedures hence the total number of procedures does not add up to 61.

Length of hospital stay

Length of stay ranged from 1 to 26 days. Of these, 160 (77%) stayed 0-5 days and 44 (21%) stayed 6- 10 days, of whom 30 had no documented reason for prolonged stay. The majority (37/44) predated 2010 when current trends for early discharge had not been implemented. The majority of cases (185/208, 89%) had drains.

BREAST-Q scores.

The BREAST-Q questionnaire was sent to 199 women and returned in 77 (39%). Median scores were high in all domains (Figures 2 and 3). Higher scores represent higher rates of satisfaction or quality of life.

The presence of chronic complications (chronic pain, shoulder stiffness etc) induced lower breast satisfaction rates (mean scores 49.4 vs 66.23; p=0.022), lower psychosocial wellbeing (48.8 vs 73.9; p=0.005), lower sexual wellbeing (30.6 vs 54.6; p=0.012), lower physical wellbeing in the chest domain (61.7 vs 76.0; p=0.039) and lower overall patient satisfaction (60.2 vs 76.7; p=0.005) compared to women who did not have complications. There was no significant difference in their satisfaction with the overall outcome of surgery (67.8 vs 78.4; p=0.227).

Women who suffered acute wound problems (flap necrosis, acute implant loss, major infection) also had lower satisfaction with outcomes (62.9 vs 80.4; p=0.18) and lower overall satisfaction (63.4 vs 77.1; p=0.006) but there were no significant differences in their long

term satisfaction with their breasts, their psychosocial, sexual or physical wellbeing.

Table 3: Comparison of outcomes against surgery types and outcomes			
Number of women developing wound infection			
	Yes	No	Total
Immediate	21	99	120
Delayed	6	82	88
Total	27	181	208
P=0.024			
Patient satisfaction score according to whether surgery was immediate or delayed (BREAST-Q)			
	Satisfied	**Dissatisfied**	
Immediate	53	16	69
Delayed	49	4	53
Total	102	20	122
P=0.027			
LDMF cases developing flap necrosis compared to radiotherapy use			
	No	Yes	
Radiotherapy	77	0	77
No radiotherapy	109	7	116
Total	186	7	193
P=0.002			

Patients who had implant-based LDMF reconstructions had higher overall satisfaction (78.9 vs 66.4; p=0.002) and higher satisfaction with the outcome of surgery (81.3 vs 68.7, p=0.044) than those who had a fully autologous reconstruction. They also had better

physical wellbeing in the chest domain of the BREAST-Q (79.9 vs 63.0; p<0.001). There was no statistical difference in satisfaction with their breasts, nor with their sexual or psychosocial wellbeing.

Patients who had multiple operations had no significant difference in BREAST-Q scores than those who only had one. There was also no difference in BREAST-Q scores between those who had immediate vs delayed reconstruction, and patients who had radiotherapy or chemotherapy compared to those who did not.

Discussion

The trends in post-mastectomy reconstruction across the UK show a rise in immediate breast reconstructions (national average of 21%, range 9-40%) with more than 85% being expander/implant and ADM based reconstructions and LDMF is declining and used in only about 5%[21,22]. Similar trends are seen in the USA and other parts of the developed world[5]. Autologous free flaps are popular in specialist care settings and are being increasingly used in delayed reconstructions[22]. LDMF reconstruction has declined in usage steadily and is used largely in delayed or salvage reconstructions. This reflects the rise in popularity of the ADM and fully autologous techniques in addition to use of the TDAP flap in some instances for whole breast reconstruction.

Immediate breast reconstruction with ADM and implants has advantages for both the surgeon and the patient over traditional LDMF reconstructions because of technical ease, shorter surgical time, higher short-term patient satisfaction and no donor site morbidity. However, nationwide audits suggest concerning complication rates (range 6-29%). The UK

National Mastectomy audit[21] evaluated outcomes of immediate breast reconstructions between 2008-2009 and found expander-based reconstructions had higher complication rates than flap-based. A decade later the multicentre, prospective iBRA study[7] analysed acute wound problems for various types of mesh and implant-based immediate reconstructions and concluded that these procedures fall short of accepted quality standards for reconstruction[7,23].

The present study showed 13% of cases with clinician reported wound infections but few (3.8%) required inpatient care or surgical exploration. This is lower than the national average and comparable with that reported in other studies on LDMF (5-8%)[23-25].

Flap necrosis was noted in 7/208 (3.4%) cases. Of these 4 had partial skin necrosis that eventually underwent secondary closure without surgical intervention. Only two patients had complete loss of the flap. Implant loss was seen in 9/139 (6%) patients of whom 3 patients had partial flap necrosis followed by implant loss due to infection. There were no cases of implant exposure or extrusion in this cohort. The NMBRA audit reported 5% partial flap necrosis for all flap based reconstructions and <1% of them had a total failure of the flap with 9% implant loss. In contrast, there is a higher rate of implant loss in ADM/implant-based reconstruction, with studies showing rates of 7-24%[7,8,26,27].

Additionally, two US nationwide surveys on acute complication rates of various breast cancer surgeries over 13 years[6] showed increased rates of acute complications (13%) for autologous flap based reconstructions, including LDMF, while in the expander/ implant group complications were low (5%). This was attributed to prolonged operative times, a risk factor for wound complications.

Donor site seroma was the most common wound problem in this cohort (120/208; 58%) with a relatively high rate despite the use of closed suction drains for all patients and quilting being used in some cases. This is to be expected in view of the large area of the donor site for this procedure[19,20]. The majority were managed with simple needle aspiration. Most LDMF series report donor site seroma as the most common complication with rates ranging from 4-80%[25,27,28,20].

Age, high BMI, smoking, radiotherapy and diabetes did not show significant associations with wound complications (but numbers of high risk patients were small). However, wound infections (including minor ones) were more frequent in immediate reconstructions compared to delayed. Wound complications are frequent in the immediate reconstruction setting in implant as well as autologous flap-based reconstructions. These results are concordant and show that adverse events, such as wound complications, negatively affect patient satisfaction.

The rate of severe capsular contracture in the autologous with implant group was low, and patients having chest wall radiotherapy showed no significant association with capsule formation. This is in contrast with expander/implant based reconstructions where the rate of capsule formation is higher (10-37.5%) following chest wall RT[29,30].

LDMF may atrophy, causing loss of volume over time and necessitating corrective procedures like fat grafting or contralateral symmetrisation. In this study 57% of cases underwent further elective procedures (median 2, range 1-12) but a large proportion of these were planned; such as nipple reconstruction, lipomodelling and exchange of implants.

Most of the 33 cases requiring multiple corrective procedures (mean 4) were in patients who had suffered complications. Interestingly, 41% (88) did not have any further corrective procedures, although some in this group did have filler port removal or surgery for cancer recurrence that were not directly related to the LDMF. Salvatore and colleagues reported that 80% (42/52) of cases who underwent elective revision surgeries were mainly for nipple reconstruction, implant exchange and fat grafting[27]. However, other retrospective series have reported up to 50% revision rates following LDMF reconstructions[15,25,31,32].

A prospective study by Nelson and colleagues[13] showed that elective secondary procedures were frequent after autologous flap based procedures (mean 0.7) but total number of secondary procedures were significantly higher in expander reconstructions (mean 2.4, $p<0.001$) and in women experiencing complications (OR 3.2, $P<0.001$). Direct to implant reconstructions have similar rates of secondary corrective surgeries to expanders (average of 21%) and are more frequent following complications or radiotherapy[32].

Several case series have reported functional deficits in the arm following LDMF reconstruction. A systematic review of functional morbidity following LDMF found shoulder morbidity rates ranging from 0-64%. Other series have shown rates of arm morbidity on long-term follow up ranging between 40-100%. Reduced shoulder strength affect patients with an active lifestyle, but the functional deficit reduces with time[2,5,17]. Donor site morbidity reported in the present study was acceptable with chronic pain or shoulder-problems reported in 10% although it may have been under-reported due to the retrospective nature of the study.

BREAST-Q scores in the present study were high in all domains, in keeping with those of other UK studies[21]. The LDMF with implant group had better levels of overall satisfaction and satisfaction with the outcome of surgery compared to autologous (Table 3). Delayed wound complications had a negative effect on the mean scores but acute wound complications showed no significant relationship with satisfaction levels.

The NMBRA audit 4th annual report had reported higher scores in all domains for pedicle flaps with or without implants compared to the implant only group[21]. The report also showed that in the immediate setting pedicled flaps with an implant have the highest satisfaction levels while in the delayed setting autologous free flaps fared the best. The implant only group had comparatively lower scores in all domains irrespective of the timing of reconstruction.

The limitations of this study are the variable length of follow-up when filling out the BREAST-Q questionnaire and so there may be a degree of recall bias as it is known that patient satisfaction varies as time passes[2,5,17]. Additionally, the response rate was only (38%, 77/199) with no data available on more than half of the cases which means we cannot exclude self-selection bias.

Conclusions

With careful patient selection and adequate patient information about the potential functional deficits, LDMF reconstruction continues to be a useful choice in post-mastectomy reconstruction with acceptable donor site morbidity, low complication rates and high patient satisfaction but elective secondary procedures are often required to complete the

reconstruction. Long term complications like capsular contracture, scarring and chronic pain negatively affect patient satisfaction but are uncommon and the technique seems to be resistant to the negative impacts of radiotherapy, making it a valuable component of the oncoplastic toolbox for use in current practice.

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Figure 1. Flow diagram for study

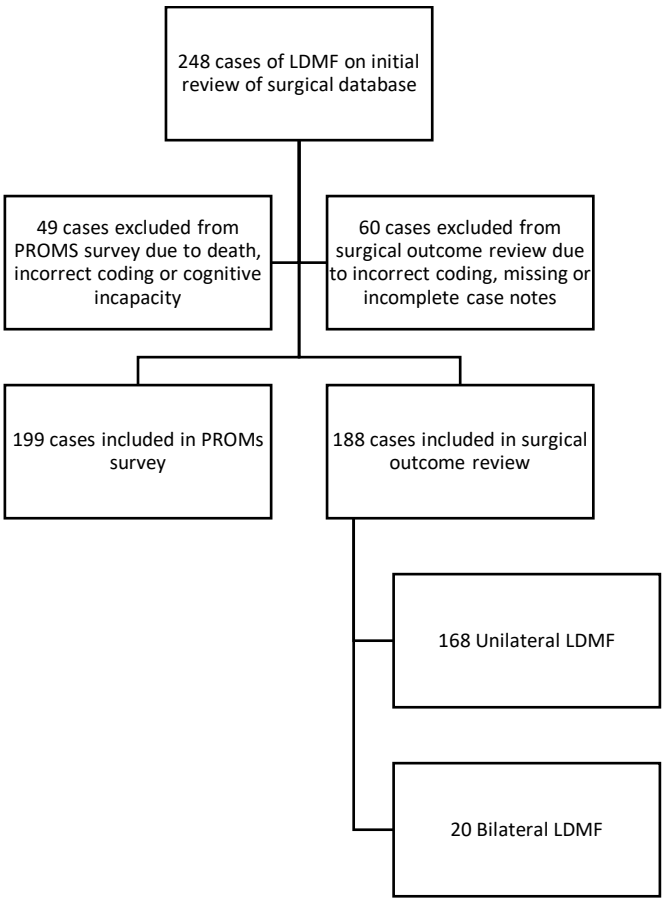

Figure 2. Overall scores for the Breast Q.

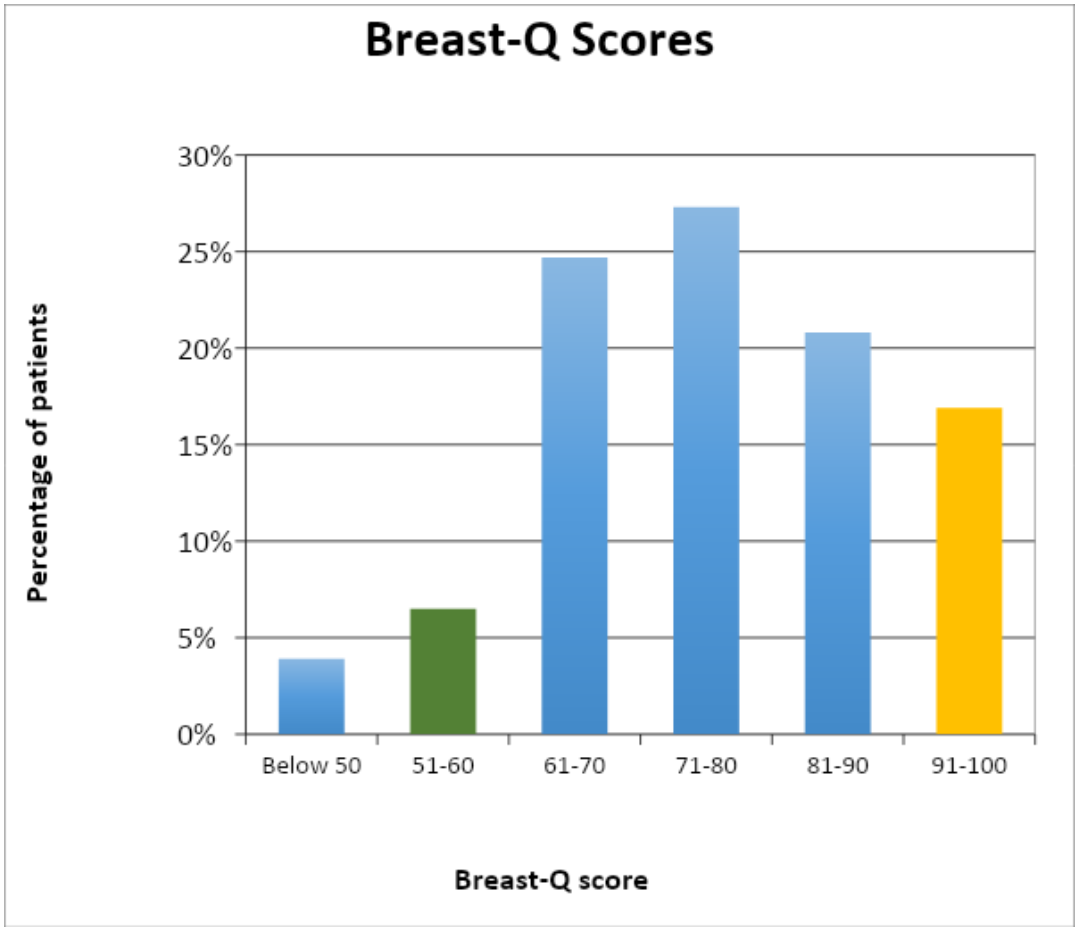

Figure 3. Box and whisker plot showing Breast Q scores by domain

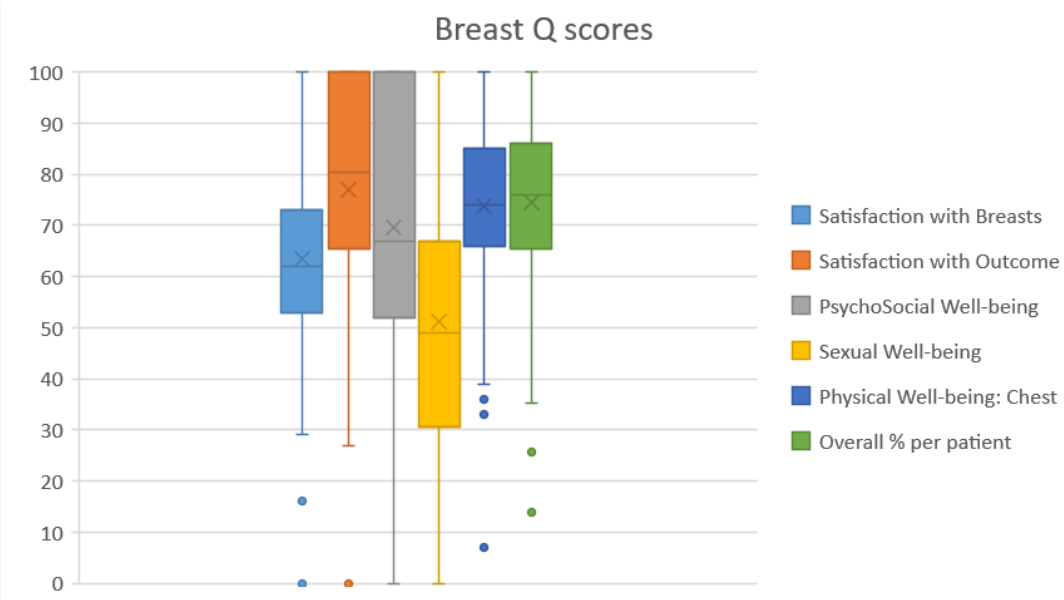

Table 1. Table showing patient characteristics

Characteristic	N (%)
Total number of patients	188 (100)
Total number of LDMFs	208
Patients with Unilateral LDMF	168/188 (90)
Patients with Bilateral LDMF	20/188 (10.6)
Median Age (Years)	49 (25-71)
Median follow-up duration (Years)	7 (2-12)
Type of LDMF	
Autologous only (extended LDMF)	68/208 (32.7)
Plus implant	139/208 (66.8)
Missing	1/208 (0.5)
Timing of LDMF	
Immediate	120/208 (57.8)
Delayed	88/208 (42.3)
Indication for Mastectomy	
Invasive cancer	177/208 (85.1)
Ductal carcinoma in situ	20/208 (9.6)

Risk Reduction	7/208 (3.4)
Missing	4/208 (2)
Axillary surgery	
No axillary surgery[1]	42/208 (20.2)
Sentinel Node Biopsy	37/208 (17.8)
Axillary node clearance	129/208 (62)
Risk Factors per LDMF procedure[2]	
Comorbidities	
Diabetes	4/208 (1.9)
Hypertension	13/208 (6.2)
Radiotherapy (RT)	106/208 (50.9)
RT Pre-LDMF	35 (17)
RT Post-LDMF	71 (34)
No RT/RT not indicated	87 (42)
Data unavailable	15 (7)
Median BMI (Range)	26 (17-42.5)
Smoker	23/208 (11)

1.For example in risk reduction and delayed reconstruction cases

2.Measured per flap as some bilateral cases were not done at the same time but consecutively

Table 2. Complications of surgery and further surgeries

Acute complications (within 3 months of surgery)	**Number (%)**
Total wound infections	27/208 (13)
Major wound infections	8/208 (3.8)
Minor wound infections	19/208 (9)
Haemorrhage/haematoma	4/208(2)
Flap necrosis	7/208 (3.4)
Acute implant loss if implant used	9/139 (6.5%)
Re-admission within 30 days of surgery	10/208 (4.8)
Seroma requiring aspiration	120/208 (58) median 2 (range 0-11)
Long term complications	
Scar related issues	30/208 (14)
Trimming of redundant skin	28/208 (13)
Chronic hematoma	1/208 (0.5)
Delayed wound healing	1/208 (0.5)
Chronic pain[1]	24/208 (11.5)

Shoulder stiffness	4/208 (1.9)
Arm weakness	9/208 (4.3)
Chronic seroma	11/208 (5.3)
Capsule formation, any grade (where implants used)	14/139 (10)
Baker grade III/IV	7/139 (5)
Implant rupture	3/139 (2)
Implant migration	2/139 (1.4)
Median number of revision surgeries (range)[2]	**2 (1-12)**
None	80/208 (38)
Number of patients having further planned procedures[3]	**61/188 (32)**
Nipple reconstruction per LDMF	39/208(19)
Lipomodelling	22/208 (11)
Expander exchange where implants used	17/139 (12)
Symmetrisation of unilateral LDMFs	30/168 (18)
Number of patients having unplanned revision surgery[3]	**13/188 (7)**
Capsulectomy	9/139 (6.4)

Capsulorrhaphy	0/139 (0)
Implant exchange	3/139 (2)
Lipomodelling/scar revision per LDMF	6/208 (2.8)
Explantation	6/139 (4.3)
Other	3/208 (1)
Length of hospital stay	
0-5 days	160/208 (77)
6-10 days	44/208 (21)
Missing	4/208 (2%)

1- Chronic pain included scar related pain, post-operative neuralgia, LD muscle spasm, shoulder and back pain.

2- Surgery for cancer recurrence and other procedures that were not for amendment of reconstruction were excluded in the table.

3 - Some cases had a combination of up to 3 procedures hence the total number of procedures does not add up to 61.

Table 3: Comparison of outcomes against surgery types and outcomes			
Number of women developing wound infection			
	Yes	No	Total
Immediate	21	99	120
Delayed	6	82	88
Total	27	181	208
P=0.024			
Patient satisfaction score according to whether surgery was immediate or delayed (BREAST-Q)			
	Satisfied	**Dissatisfied**	
Immediate	53	16	69
Delayed	49	4	53
Total	102	20	122
P=0.027			
LDMF cases developing flap necrosis compared to radiotherapy use			
	No	Yes	
Radiotherapy	77	0	77
No radiotherapy	109	7	116
Total	186	7	193
P=0.002			