Original Article

Trends in breast reconstruction techniques at a large safety net hospital: a 10-year institutional review

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Background: Multiple barriers in obtaining breast reconstruction were recently elucidated; however, long-term trends in those who undergo the procedure remain unclear. The purpose was to evaluate breast reconstruction technique within a large safety net hospital over 10 years.

Methods: Single center, retrospective, observation study of breast reconstructions from 2005 to 2014. Outcome data were grouped into two consecutive 5-year periods (period 1: 2005–2009; period 2: 2010–2014) and evaluated for changes over time.

Results: Over a 10-year period, 188 patients underwent breast reconstruction. Eighty percent carry MediCal, 57% are non-English speaking, and 73% are Hispanic. The mean age was 48 (range, 17–70) years. From period 1 to 2, there were no changes in breast cancer diagnosis type (P>0.19), in timing of reconstruction (P>0.05), or in implant-based reconstructions (P=0.77). There was an increase in the number of therapeutic, prophylactic, and bilateral mastectomies, and in breast reconstruction procedures performed overall (P<0.01). There was a significant increase in free flap reconstructions from 33.3% in period 1 to 50.8% in period 2 (P<0.03) and a decrease in pedicled breast procedures from 31.7% to 12.4% (P<0.01).

Conclusions: In a predominantly low-income population, there was a significant rise in the use of the free flap, amidst an increase in the number of breast reconstructions overall. Autologous reconstruction and delayed reconstruction remain dominant.

Keywords: Breast reconstruction; free flaps; pedicled flaps; autologous reconstruction (AR); delayed reconstruction

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Introduction

In the United States, 35 to 40 percent of women diagnosed annually with breast cancer will undergo total mastectomy. Out of those who do, historically only 25% subsequently chose to have immediate breast reconstruction (1-6), despite the enactment of the 1998 Women's Health and Cancer Right Act to expand insurance coverage for reconstruction procedures. More recently, however, a significant rise in breast reconstruction was documented over a 10-year period from 1998 to 2008, with a 203 percent increase in implant use (7). Furthermore, breast reconstruction following total mastectomy has been correlated with benefits in body image, self-esteem, sexuality, and quality of life (8-14).

Despite these benefits, women from lower income households are significantly less likely to undergo reconstruction. Significant obstacles to reconstruction have been identified that reflect specific socioeconomic and demographic factors—factors that are pervasive within the underserved population in our study. In fact, insufficient healthcare resources represent significant barriers to

Table 1 Sociodemographic characteristics of patients

Characteristics	Patients (n=188)
Age at reconstruction, median [range] (years)	48 [17–70]
Body mass index (BMI), median [range] (kg/m^2)	28 [16–50]
Language, n [%]	
English	40 [21]
Spanish	51 [27]
Other	8 [4]
Unknown	97 [52]
Ethnicity, n [%]	
Caucasian	18 [10]
Hispanic	138 [73]
Black	9 [5]
Asian	27 [14]
Native American	1 [1]
Other	1 [1]
Unknown	2 [1]
Insurance payer, n [%]	
MediCal	151 [80]
Outpatient Reduced-Cost Simplified Application (ORSA)	16 [9]
Insurance for In-Home Supportive Services (IHSS)	10 [5]
Self-pay	4 [2]
Healthy Way LA (HWLA)	2 [1]
General relief	2 [1]
Medicare	2 [1]
Private insurance	1 [1]
Distance to hospital, n [%]	
<10 miles	95 [51]
10–20 miles	74 [39]
>20 miles	19 [10]

immediate breast reconstruction and timely care (15). And in those who choose to undergo reconstruction, socio-demographic variables and teaching hospital status also play a role in the type of reconstruction performed (16). While overall trends in breast reconstruction in the United States have been reported, little is known about long-term changes in breast reconstruction techniques that are specific to this population and its socioeconomic challenges. Therefore, the purpose of our study was to (I) identify the subtypes of breast reconstruction procedures, (II) evaluate the frequency and change in procedure techniques over a 10-year period, and (III) ultimately provide an analysis on trends in breast reconstruction unique to this population.

Methods

A retrospective chart review, approved by Institutional Review Board of University of Southern California (USC) (USC IRB #HS-10-00692), was conducted on a 10-year period between September 2005 and September 2014, at Los Angeles County + USC Medical Center (LAC + USC) in Los Angeles, California. LAC + USC is one of the largest and busiest public hospitals in the United States, and is the largest single provider of healthcare in the Los Angeles County. It serves as a safety-net hospital for Los Angeles County, servicing the lower income, uninsured, and venerable populations within the area.

Records for all patients who underwent breast reconstruction at LAC + USC during this time period were examined. Both delayed and immediate reconstructions were included. Data were collected using a standardized data sheet reflecting the patient profile and demographic information, anthropometric data, risk factors, operative procedure, and clinical outcome. Outcome data was grouped into two consecutive 5-year periods, with period 1 being 2005–2009 and period 2 being 2010–2014. These groups were subsequently evaluated and compared for changes in techniques and outcome over time.

Statistical analysis was performed using chi square and Mann-Whitney analysis for the difference between 2 proportions to assess the probability of a significant difference in the data for period 1 and period 2 parameters.

Results

From 2005 to 2014, a total of 188 female patients underwent breast reconstruction. The mean age at the time of mastectomy and reconstructive procedure was 46 (range, 2–68) years and 48 (range, 17–70) years, respectively. Follow-up after reconstruction ranged from 2 to 153 months, with a mean of 35 months.

Demographics

Patient demographic information is listed in *Table 1*. Within

Table 2 Comparison of breast reconstruction procedure type between period 1 and period 2

Procedure type	Period 1: 2005–2009		Period 2: 2010–2014		P value
	Patient number	% of total procedures	Patient number	% of total procedures	
Implant	21	35.0	48	36.9	0.77
Free flap	20	33.3	66	50.8	<0.03
DIEP	4	6.7	19	14.6	0.49
TRAM	16	26.7	47	36.2	
Pedicled	19	31.7	16	12.3	<0.01
Latissimus	11	18.3	15	11.5	<0.02
TRAM	8	13.3	1	0.8	
Total	60	100.0	130	100.0	–

this population, 73% was Hispanic, 14% was Asian, 10% was Caucasian, 5% was African American, and 1% was either Native American, another ethnicity, or unknown. Eighty percent carried MediCal—California's form of Medicaid—as the primary form of insurance, whereas less than 1% utilized private insurance. A majority (61%) was married, and the mean size of patients' households was four people. The predominant language used in the patient-physician interaction was Spanish (27%), followed by English (21%). Forty-nine traveled greater than 10 miles to get to LAC + USC. Of those with available information, 25% admitted to smoking either formerly or currently, whereas the majority (75%) denied any history of smoking. The average BMI was 28 kg/m^2, and the average age at menarche was 13.2 years.

Procedure specifics

Eighty-eight patients underwent immediate reconstruction (46.6%) and 101 received delayed (53.4%) reconstructions. The duration of time between mastectomy and reconstruction ranged from immediate reconstruction to 332 months, which is almost 14 years following the initial mastectomy surgery. The average duration to reconstruction was 14 months.

Procedure types grouped by time period are listed in *Table 2*. Sixty-nine patients (36.5%) received tissue expander or implant reconstructions. A total of 121 patients underwent autologous reconstruction (AR). There were 26 latissimus dorsi pedicle flaps (74.3%) and 9 TRAM pedicle flaps (25.7%). Eighty-six patients underwent free tissue transfer with DIEP [23 (26.7%)] or TRAM flaps [63 (73.3%)].

Trends over time

Results are listed in *Table 3*. From period 1 to period 2, there was no change in breast cancer diagnosis type (P>0.19) nor in timing of reconstruction (P>0.05). The number of patients with results for genetic screening increased, and was significantly higher from period 1 to period 2 in BRCA negative (P=0.029) and BRCA2 positive patients (P=0.04). There were no significant changes over time in radiation therapy or chemotherapy regimen. Significantly, more patients in period 2 underwent or are currently undergoing hormonal therapy with tamoxifen (P=0.007).

Additionally, there was an increase in number of therapeutic, prophylactic and bilateral mastectomies as well as breast reconstruction procedures performed overall (P<0.01). Implant-based reconstruction remained constant, with 35.0% of period 1 *vs.* 36.9% of period 2 breast reconstructions (P=0.77). There was a significant increase in free flap reconstructions, 33.3% in period 1 *vs.* 50.8% in period 2 (P<0.03) and a decrease in pedicled breast procedures 31.7% in period 1 *vs.* 12.3% in period 2 (P<0.01). There was no significant increase in the number of DIEP *vs.* TRAM free flaps used (P=0.49). There were no significant changes in complication rates between the period 1 and period 2 (P=0.07) (*Table 4*). Overall flap failure rates were less than 1%, while skin flap necrosis rates were 8%.

Discussion

In 2012, Albornoz *et al.* reported a 78% increase in breast

Table 3 Clinical characteristics of patients

Characteristics	Period 1 (n)	Period 2 (n)	P value
Preop dx			
DCIS	16	31	0.80
LCIS	0	3	0.19
IDCA	45	73	0.35
ILCA	1	2	0.90
IDCA + ILCA	0	1	0.45
Other cancer	5	4	0.20
Non-cancer	7	8	0.35
Unspecified	10	11	0.22
BRCA status			
BRCA1/2–	33	40	<0.03
BRCA1+	5	11	0.70
BRCA2+	0	7	<0.05
BRCA1/2+	0	2	0.29
ER status			
ER–	18	34	0.87
ER+	41	67	0.40
PR status			
PR–	19	40	0.50
PR+	40	61	0.20
HER status			
HER–	34	68	0.49
HER+	18	20	0.09

Preop dx, pre-operative diagnosis; DCIS, ductal carcinoma in situ; LCIS, lobular carcinoma in situ; IDCA, invasive ductal carcinoma; ILCA, invasive lobular carcinoma; ER, estrogen receptor; HER, human epidermal growth factor receptor; PR, progesterone receptor.

reconstructions in the period from 1998 to 2008 (16). With this study, we continued to observe an increase in breast reconstruction procedures from 2005 to 2014, as was also observed by Jagsi *et al*. (17) in 2014, especially in patients who received bilateral mastectomies. Albornoz *et al.* also observed an increase in implant rates, in addition to stable or declining rates of autologous procedures amidst an increase in implant procedures (16). This is all despite the higher risk of reconstructive failure and surgical site infection shown in implant *vs.* AR (18). In this study, we did not find an increase in implant rates over time. Perhaps these trends are due to the characteristics unique to this patient population, as we also observed an increase in free flap procedures and the dominant use of AR overall. Interestingly, one study found racial differences in the use of free flaps and pedicled flaps, in that African Americans undergoing pedicled TRAM flap are at higher risk for fat necrosis but not mastectomy flap necrosis or partial flap necrosis (19). This means that when it comes to reconstructive surgery, the patient's sociodemographic background represents more than "patient information" within the health record. In fact, the presence of disparities in reconstruction is not solely dependent on patient preference or anatomical characteristics. Rather, women aged 50 to 59 years, treated at teaching hospitals, with private insurance, of lower income, or undergoing delayed reconstruction were more likely to receive AR over implants (16). Implant use was associated with young patients, Asians, Caucasians, and higher income. These identified factors, with the exception of private insurance, might help explain the dominant use of AR within this population, which is predominantly older in age, Hispanic, and lower-income.

Our population consisted of mostly Hispanic, lower-income based on insurance status, who predominantly do not speak English and traveled over 10 miles to get to the hospital. Insurance plan and distance to care have both been identified as significant barriers to obtaining breast reconstruction (20,21). This means that while many of the patients in our sample faced these barriers, they were still able to receive breast reconstruction. Roughton *et al.* suggested that distance to care as a barrier to reconstruction may be ameliorated when reconstruction occurs in a delayed setting. Indeed, our results show a slight dominance of delayed reconstruction over immediate reconstruction. While immediate reconstruction is preferred and is traditionally associated with arguably superior results (21), the delayed setting, and the elective timing it can provide, may help address the immediate needs of the cancer patient, such as excision and adjuvant therapies. The patient is then also free to pursue other goals, which may include breast reconstructive surgery. And despite the general conception that the uninsured and low-income are less satisfied with the results of their reconstruction procedures, patients at LAC + USC demonstrate comparable satisfaction levels to other reports in literature (22).

Furthermore, we observed an increase over time in the number of patients with genetic screening results,

Table 4 Comparison of breast reconstruction complications between period 1 and period 2

Complications	Period 1: 2005–2009 (n=70)		Period 2: 2010–2014 (n=177)		P value
	Patient number	%	Patient number	%	
Infection	12	17	22	12	0.49
Seroma	4	6	4	2	0.25
Hematoma	2	3	2	1	0.59
Wound dehiscence/exposure of implant or breast	2	3	10	6	0.36
Skin flap necrosis/ulceration	4	6	17	10	0.32
Fat necrosis	2	3	10	6	0.36
Reoperation for any reason	1	1	2	1	0.99
DVT/PE	0	0	0	0	0.99
TE/implant rupture or deflation	1	1	7	4	0.44
Capsular contracture	4	6	2	1	0.07
Total	32	–	76	–	–

DVT/PE, deep vein thrombosis/pulmonary embolism; TE, tissue expander.

with significant increases in BRCA1/2 negative and BRCA2 positive results. This likely highlights the increased awareness of these tests and their relationship to prophylactic and bilateral mastectomies (23), in that test results like those of BRCA1/2 significantly affect patients' surgical decision-making. Women who knew that they carried BRCA mutations were more likely to view mastectomy as the best way to reduce future breast cancer recurrence while avoiding multiple surgeries and radiation (24). It is therefore important for us to characterize trends of breast surgeries in a time when technological advancements, such as those of genetic testing, are increasingly pervasive in not only diagnosis but also management of diseases.

Nevertheless, this study is not without limitations. While care was given to data collection from patient charts, data was occasionally inconsistently recorded in the database or unavailable, possibly leading to skewed results. Data was also likely more consistent in period 2, as older medical records within the electronic database is less reliable. The service at LAC-USC is also an academic center composed of residents and fellows in addition to senior physicians, which we speculate impacts the amount of breast reconstructions completed. We recognize that LAC-USC is not a breast center; consequently, the volume of breast surgeries completed at this institution is expected to be low compared to a breast center or institution with higher volume. In addition, low-income status was inferred based on Medicaid status, as specific income information was not readily available. Our sample only included patients served by LAC + USC, so it is not necessarily representative of all low-income populations. It is also likely additionally influenced by regional differences, as has been reported in other studies (25). Lastly, while our population was predominantly non-Caucasian and on government-subsidized insurance, we did not separate results and compare by factors such as ethnicity or insurance type. We would, however, like to do so in future studies.

Our data extends until September 2014, but of note is the insurance expansion under the Affordable Care Act in January of 2014. While our data does not cover enough time to observe any possible changes as a result of this expansion, it will be interesting to see how this expansion will affect breast reconstruction in a demographic like ours—one that traditionally faces decreased access to care. Even so, it will also be important to study how these changes can be influenced by multiple factors. In fact, Mahmoudi *et al.* demonstrated in 2015 that increased Medicaid coverage without providing additional support may be ineffective in reducing disparities in healthcare (26). We anticipate that changes in reimbursement throughout this time can also influence practice patterns. This has been documented within other specialties, such as with drug therapy in Europe and vaccine recommendation (27,28). And

interestingly, Hernandez-Boussard *et al.* found that from 1998 to 2008, the number of AR decreased while Medicare reimbursement for AR also declined (29). Our data does not include reimbursement details on each procedure; further research could help elucidate the impact of insurance and reimbursement changes on rates of breast reconstruction. In addition, it is worth noting that our study spans a 10-year period during which many changes have likely taken place in medicine and in breast reconstruction. It is possible that these trends may either be simply related to new emerging techniques that result in superior aesthetic results, or to a training bias without accounting for outcomes. To our knowledge, there was no significant turnover in surgeons during this time-period, which if so, would have created an additional bias in breast reconstruction trends.

Nevertheless, our study demonstrates that factors unique to our hospital and patient population, whether related to socio-economic status of the patients or to the nature of this institution, may be very much related to trends that we see in breast reconstruction techniques at this hospital. As such, it will be important in future research to investigate whether these trends also hold true at other institutions and within the general population.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/abs.2017.12.05). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Institutional Review Board of University of Southern California (USC) (USC IRB #HS-10-00692). Informed consent was taken from all individual participants.

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