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Rise in Microsurgical Free-Flap Breast Reconstruction in Academic Medical Practices

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Background: Previous studies have examined national trends in breast reconstruction, using various data sets demonstrating increases in implant-based reconstruction and decreases in autologous reconstruction. However, academic breast reconstruction practices have never been specifically characterized. The University Health Consortium—Association of American Medical Colleges Faculty Practice Solutions Center database contains comprehensive, factual billing and coding data from 90 academic medical centers in the United States, and has been used to characterize practice patterns of various academic surgical specialties.

Objective: To describe breast reconstruction trends unique to academic surgical practices, using the Faculty Practice Solutions Center database.

Methods: Annual data for defined breast reconstruction procedures (current procedural terminology codes: 19340, 19342, 19357, 19361, 19364, 19366, 19367, 19369, and 19380) performed by university plastic surgeons during calendar years 2007 to 2013 were included in the study.

Results: From 2007 to 2013, a 2-fold increase in the number of breast reconstruction procedures was observed (from a mean of 45.3 to 94.2 procedures per surgeon). During this period, implant-based reconstructions and autologous reconstructions rose in tandem (28.9–44.6 and 11.4–19.3, respectively), with a preserved 2.5:1 ratio between the 2 categories each year. When compared to reconstructions overall, the proportion of both implant reconstruction and autologous reconstruction procedures declined, since revision and other types of reconstructions increased (11% of all reconstructions in 2007 vs 32% in 2013). With regard to autologous reconstruction, microsurgical free flaps (mostly comprised of deep inferior epigastric artery perforator flaps) have supplanted latissimus flaps as the favored modality and comprised 13% to 14% of breast reconstruction cases overall from 2011 to 2013.

Conclusion: In contrast to national trends, university-based plastic surgeons are performing a growing number of microsurgical free flaps as the preferred method for autologous breast reconstruction. Whereas implant-based reconstructions still predominate in academic practices, the trend of increasing preference toward implant-based reconstructions has slowed in recent years and revision reconstructions are on the rise.

Key Words: microsurgery, free flap, DIEP, perforator, autologous, breast reconstruction, academic surgery

(*Ann Plast Surg* 2015;74: S62–S65)

BACKGROUND

Recent papers on breast reconstruction practices highlight the national trend toward implant-based reconstructions. In the Nationwide Inpatient Sample (NIS), implant-based reconstructions rose by 11%

annually from 1998 to 2008, whereas autologous reconstructions decreased by 5% per year.¹ Immediate reconstructions, mostly implant based, also increased by 5% yearly, with a near-doubling reported in a Surveillance, Epidemiology, End-Results database analysis.² Associated with this trend, a growing incidence of elective mastectomy and contralateral prophylactic surgery in lieu of breast conservation has been described in several large studies.^{3,4}

Implant-based reconstructions are often an attractive option for patients and practitioners. Primary implant reconstructions are generally less technically challenging, requiring less intraoperative time, with more favorable insurance reimbursement when compared to autologous reconstructions.¹ More rapid postoperative recovery and avoidance of donor site morbidity are also reasons that may help explain the greater number of practices offering only implant-based reconstruction versus the full spectrum of autologous reconstructions and microvascular free flaps.⁵

However, breast implants have negative implications. Over time, implant-based reconstructions can develop capsular contracture, rippling, implant migration, asymmetry, and implant rupture.⁶ In contrast, autologous reconstructions age more naturally with the patient and may even look better over time. Recent investigations into patient education protocols have demonstrated a greater proportion of patients with a stated preference for autologous repairs in clinical settings.⁷

For revision reconstructions of previous implant-based repairs, various modalities are used including autologous tissue transfer, fat grafting, implant exchange, and placement of acellular dermal matrix. The use of microvascular techniques and specifically, deep inferior epigastric artery perforator (DIEP) flaps for revision reconstruction is also well documented.^{8,9} In various contexts, microsurgical free flaps are associated with high patient satisfaction and favorable aesthetic outcomes.^{10–12} The effect has been that practices offering free flap expertise have evolved into referral hubs for all types of breast therapy.¹³ Characterizing these practices can help us understand the recent impact of changing patients' preferences for primary reconstruction and emerging strategies for revision reconstruction.

OBJECTIVE

The objective of this paper was to analyze breast reconstruction practices of academic plastic surgeons using the Faculty Practice Solutions Center (FPSC) database. The University Health Consortium—Association of American Medical Colleges maintains the FPSC database, which contains comprehensive coding and billing data from 90 academic medical centers (comprising more than two thirds of qualifying institutions), encompassing all procedures performed at these facilities for all payer types in both inpatient and outpatient settings by individual specialty. Roughly 300 plastic surgeons (full-time, part-time, and adjunct faculty) are represented. Previously, the FPSC database has been used to characterize practice patterns of other surgical specialties.^{14,15}

MATERIALS AND METHODS

Annual data for defined breast procedures [current procedural terminology codes: 19316, 19318, 19324, 19325, 19328, 19330, 19340, 19342, 19350, 19355, 19357, 19361, 19364, 19366, 19367, 19369, 19370, 19371, 19380, and 19399] performed by university

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TABLE 1. Breast Reconstruction Procedures by CPT Code (FPSC)

Breast Reconstruction Type	Mean Annual Procedures Per Surgeon						
	2007	2008	2009	2010	2011	2012	2013
Implant	28.9	30.8	28.0	41.9	42.7	42.8	44.6
19340—Immediate breast prosthesis	15.4	17.8	16.2	5.7	6.0	7.4	9.1
19342—Delayed breast prosthesis	10.5	10.2	9.1	10.9	11.8	9.2	8.4
19357—Tissue expander, immediate or delayed	2.9	2.8	2.8	25.3	24.9	26.1	27.1
Autologous	11.4	15.7	15.1	12.9	16.9	17.0	19.3
19361—Latissimus flap	9.4	12.9	12.6	3.2	3.4	3.5	3.9
19364—Free flap, microvascular	0.2	0.2	0.3	7.1	10.9	11.6	12.5
19367—TRAM flap, single pedicle	0.2	0.3	0.2	2.6	2.5	1.9	1.9
19369—TRAM flap, double pedicle	1.7	2.2	2.0	0.1	0.1	0.0	1.0
Miscellaneous	5.0	3.9	3.8	16.5	22.7	20.8	30.3
19380—Revision reconstruction	0.0	0.0	0.0	14.9	21.0	19.8	22.1
19366—Reconstruction, other technique	5.0	3.9	3.8	1.6	1.7	1.0	8.2
Total	45.3	50.4	47.0	71.3	82.4	80.6	94.2

plastic surgeons during calendar years 2007 to 2013 were included in the study. Both average frequency numbers and average annual work relative value units (wRVUs) from the FPSC are presented here.

More recent data from the NIS from 2008 to 2011 are also cross-referenced to examine the proportional makeup of microvascular free-flap breast reconstruction subtypes such as free transverse rectus abdominis myocutaneous flap (TRAM), DIEP, superficial inferior epigastric artery, gluteal artery perforator, and other perforator free flaps. No individual CPT codes exist for these procedures; all are included under the general CPT code of 19364 for microsurgical free tissue reconstruction of the breast. The NIS, from 2008 onward, includes national totals for diagnosis-specific *International Classification of Diseases, Ninth Revision* codes, 85.73, 85.74, 85.75, 85.76, and 85.70 for the various free flap subtypes. Data from all centers, not limited to academic, performing free flap breast reconstruction, were compiled using the Statistical Package for the Social Sciences program (IBM, NY).

RESULTS

From 2007 to 2013, an overall 2-fold increase in the total number of breast reconstructions procedures was observed (from a mean of 45.3–94.2 procedures per surgeon) (Table 1). All 3 categories, implant, autologous, and miscellaneous types of reconstruction, demonstrated a rise during this period. Implant-based reconstructions increased from 28.9 to 44.6 procedures per surgeon, autologous reconstructions increased from 11.4 to 19.3, and miscellaneous reconstruction, which includes revision reconstructions, increased from 5.0 to 30.3. Most implant-based reconstructions in more recent years involved the use of tissue expanders, with the highest reported mean of 27.1 procedures per surgeon in 2013. The autologous reconstruction category,

previously dominated by latissimus flaps, was more recently comprised primarily of microvascular free flap repairs with the highest reported mean of 12.5 procedures per surgeon in 2013. The miscellaneous category in Table 1 includes revision reconstructions and reconstructions using other techniques without specific designation of implant-based or autologous methods in each. In more recent years, from 2010 to 2013, the number of revision reconstructions increased from 14.9 to 22.1 procedures per surgeon and comprised 20% to 25% of the total breast reconstruction procedures overall. Supercharged TRAM with microvascular anastomosis (CPT 19368) failed to reach a notable threshold (at least one half procedure per surgeon) throughout the study period and was therefore not included in the present analysis.

The rise in both implant-based reconstructions and autologous reconstructions over this period was constant, with a preserved 2.5:1 ratio between the 2 categories each year (Table 2). Compared to reconstructions overall, the proportion of primary implant and autologous reconstruction procedures seemed to be declining, since revision and other types of reconstructions were on the rise. Miscellaneous reconstructions comprised 11% of all reconstructions in 2007 versus 32% in 2013. In autologous reconstruction, microsurgical free flaps supplanted latissimus flaps as the favored modality and comprised 13 to 14% of breast reconstruction cases overall from 2011 to 2013. From 2007–2009, additional centers were added to the database, which contributed to some early discrepancies in the reported data.

Cross-referencing available NIS data from all medical centers, the predominant rise in microvascular breast reconstruction was seen in DIEP flaps and free TRAM flaps, which comprised 63% and 29% of free flap reconstructions, respectively in 2013 (Table 3). In 2008, free TRAM flap was the most popular modality for free flap breast reconstruction and comprised more than half of all cases. However, in more recent years, DIEP emerged as the preferred modality by a wide margin.

TABLE 2. Implant-Based Versus Autologous Reconstruction Procedures by CPT Code (FPSC)

Breast Reconstruction Procedure	Portion of Total Annual Procedures (%)						
	2007	2008	2009	2010	2011	2012	2013
Implant (19340, 19342, 19357)	64	61	60	59	52	53	47
Autologous (19361, –64, –67, –69, –70, –71)	25	31	32	18	21	21	20
Free flap, microvascular (19364)	0	0	1	10	13	14	13
Miscellaneous (19366, –80)	11	8	8	23	28	26	32

TABLE 3. Microvascular Breast Reconstructions by ICD-9 Code (NIS)

Free Flap Type	Portion of Total Annual Procedures (%)			
	2008	2009	2010	2011
Free TRAM	50.7	36.4	39.7	29.4
DIEP (85.74)	39.4	50.7	52.0	62.7
SIEA (85.75)	2.5	3.5	3.5	1.4
GAP (85.76)	1.2	1.3	1.0	1.8
Perforator, other (85.70)	6.2	8.1	3.8	4.8

GAP, gluteal artery perforator, SIEA, superficial inferior epigastric artery.

Superficial inferior epigastric artery, gluteal artery perforator, and other perforator flaps remained least popular, contributing single-digit percentages to annual totals.

The mean wRVU generated by breast plastic surgery procedures increased from 2010.1 in 2007 to 2455.1 (Table 4) in 2013. Breast reconstruction comprised one third of total wRVUs in 2007 but more than two thirds of wRVUs in 2013. This change represented a greater than 2-fold increase from 678.5 wRVU per surgeon in 2007 to 1661.1 in 2013. From 2011 to 2013, the proportion of wRVU generated from implant reconstruction and autologous reconstruction were quite similar, with only 3% difference between the 2 categories annually, in relation to the total. Breast reductions constituted 15% of wRVUs in 2013 and as high as 20% in 2010; whereas augmentation, nipple-areola complex reconstruction, and other breast procedures (such as mastopexy, capsulotomy, capsulectomy, and implant removal) demonstrated relative decline, contributing single-digit percentages to the overall total in more recent years.

DISCUSSION

In comparison to other data sets, the FPSC helps evaluate specialty academic practices using procedure-specific CPT codes instead of diagnosis-specific *International Classification of Diseases, Ninth Revision* codes from insurance providers. The effect is that billed procedures are not excluded based on payer type, diagnosis, or inpatient/outpatient status, offering the most precise measure of clinical activity of member academic institutions. The limitation of the FPSC

data set, as previously mentioned, is that less representative data points emerged from earlier years when centers were added.

Several notable trends in breast reconstruction have been reported in previous studies, mainly the ongoing rise in implant-based reconstruction, and continued popular use of latissimus flaps for autologous reconstruction.^{1,2,16} Although the present study confirms that implant-based reconstructions are still the preferred method for primary reconstruction in academic institutions, the trend toward their increasing use year to year has tapered. The most notable finding of the present study is the prominence of microsurgical reconstruction and revision reconstruction in academic settings (Fig. 1). Several factors may be influencing these practice patterns.

First, as a nature of their practice, academic plastic surgeons have a responsibility to train residents in the full gamut of reconstructive options and may be more inclined to follow clinical evidence that supports microsurgical techniques in various applications, despite diminishing financial incentive to the institution. Several studies examining the long-term results for implant-based reconstructions versus autologous reconstructions have found that aesthetic results are better with autologous tissue, with less overall cost to insurance payers if revision procedures are taken into account.^{17,18} However, surgical practices are not directly rewarded for their up-front investments in these cases.

Second, whereas some rise in revisions may be explained by changes in CPT coding, evolving practice patterns are the main contributor. We surmise that the stark rise in breast reconstructions in the past 2 decades and improved disease-free survival patients with in breast cancer have produced more cases of late complication of earlier implants requiring revisions and touch-up. Moreover, popularized use of acellular dermal matrix and fat grafting may also lead to increased efforts to nurse aging implants along explaining the rise in coding and billing for revision and miscellaneous reconstructions.^{19,20}

Although the financial incentive for primary autologous reconstructions remains relatively poor compared to implant-based reconstructions, medical centers offering the full range of reconstructions may experience an influx of new patients to their respective medical and surgical oncology practices, indirectly offsetting costs. Some centers have also been able to negotiate better reimbursement from insurance carriers for microsurgical reconstruction, and better remuneration for their surgeons.²¹ The decrease in augmentation (7%–4%) and mastopexy (32%–4%) procedures from 2007 to 2013 is further evidence suggesting the proportion of self-payers is declining in the current economy and academic plastic surgery practices have reoriented

TABLE 4. Overview of Breast Plastic Surgery Procedures (FPSCs)

Procedures	Mean Annual Work Relative Value Units						
	2007	2008	2009	2010	2011	2012	2013
Breast reduction	1.1 (0.1%)	1.6 (0.1%)	1.4 (0.1%)	442 (20%)	469.5 (18%)	382 (16%)	371.1 (15%)
Breast augmentation	143.9 (7%)	148.3 (7%)	122.7 (6%)	61.1 (3%)	104.7 (4%)	67.3 (3%)	86.3 (4%)
Breast reconstruction	678.5 (34%)	766.6 (35%)	727.4 (36%)	1323.9 (59%)	1563.6 (61%)	1559.8 (64%)	1661.1 (68%)
Implant	288 (14%)	296.7 (14%)	271.9 (13%)	685.9 (31%)	694.4 (27%)	703.4 (29%)	735.3 (30%)
Autologous	282 (14%)	386 (18%)	372.9 (18%)	448.3 (20%)	613 (24%)	628.2 (26%)	653.1 (27%)
Revision/Other	108.5 (5%)	83.9 (4%)	427.3 (21%)	130.8 (6%)	130.4 (5%)	127.3 (5%)	127.9 (5%)
Nipple/Areola reconstruction	315.6 (16%)	455.1 (21%)	427.3 (21%)	130.8 (6%)	130.4 (5%)	127.3 (5%)	127.9 (5%)
Auxiliary breast procedures	868 (43%)	813.4 (37%)	729.9 (36%)	257.3 (11%)	263 (10%)	262.3 (11%)	202.1 (8%)
Mastopexy	634 (32%)	561.7 (26%)	512 (25%)	80.1 (4%)	97.3 (4%)	84.5 (3%)	86.2 (4%)
Capsulotomy/ectomy	197.5 (10%)	216 (10%)	191.9 (10%)	140.2 (6%)	135.8 (5%)	145.5 (6%)	90.4 (4%)
Implant removal	36.5 (2%)	35.7 (2%)	26 (1%)	37 (2%)	29.9 (1%)	23.6 (1%)	6.6 (0.3%)
Unlisted breast procedure	3.0 (0.1%)	8.4 (0.4%)	8.1 (0.4%)	24.2 (1%)	14.2 (1%)	23.6 (1%)	6.6 (0.3%)
Total	2010.1	2193.4	2016.8	2239.3	2422.3	2455.1	

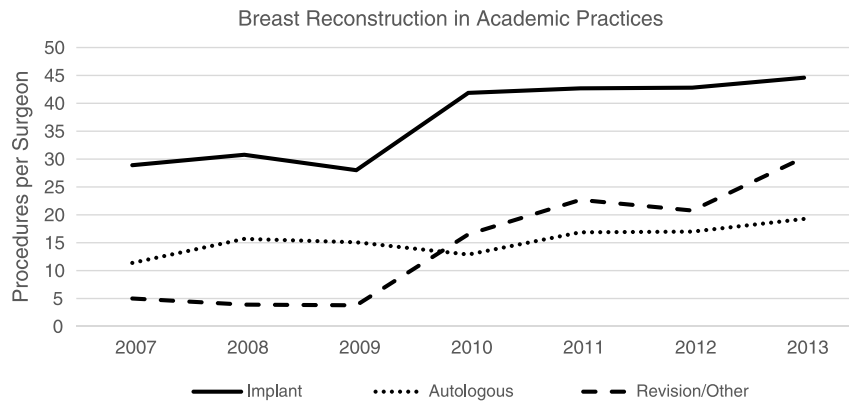


FIGURE 1. Breast reconstruction procedures performed by academic plastic surgeons (FPSC).

their efforts toward more insurance-based procedures, such as breast reduction and reconstruction.

The authors predict in the coming years that a continued rise in microsurgical breast reconstruction will be triggered by a growing public awareness and demand for the full breath of breast reconstruction options and a better understanding of the true total cost for breast reconstruction and its subsequent maintenance. Whereas there are many private practitioners capable of providing these microsurgical services, larger academic medical centers will likely be the ones who will continue to provide these resource-intensive procedures and thus uniquely positioned to negotiate more favorable reimbursements from insurance providers.^{22,23}

CONCLUSIONS

In contrast to national trends demonstrating increases in implant-based reconstruction and declines in autologous reconstruction, university-based plastic surgeons' breast reconstructive practices differ. Implant-based breast reconstructions, showing considerable rise in previous years, have plateaued, reaching a steady state in many academic practices. Microsurgical free flaps, and specifically DIEP repairs, predominate autologous breast reconstructions and continue to rise in popularity. Revision procedures now comprise a quarter of all breast reconstructions at academic facilities, highlighting their growing importance. Insurance-based procedures like breast reconstruction and reduction have mostly replaced self-pay procedures, such as breast augmentation and mastopexy, highlighting the changing practice of academic plastic surgeons in the current health care climate.

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