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The Influence of Physician Payments on the Method of Breast Reconstruction: a National Claims Analysis

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Abstract

Introduction—Flap-based breast reconstruction demands greater operative labor and offers superior patient reported outcomes compared to implants. However, implants continue to outpace flaps, with some suggesting inadequate remuneration as one barrier. This study aims to characterize market variation in the ratio of implants to flaps and assess correlation with physician payments.

Methods—Using the Blue Health Intelligence database from 2009–2013, patients were identified who received tissue expander (i.e. implant) or free-flap breast reconstruction. The ratio of implants/flaps and physician payments was assessed using quadratic modeling. Matched bootstrapped samples from the early and late periods generated probability distributions, approximating the odds of surgeons switching reconstructive method.

Results—21,259 episodes of breast reconstruction occurred within 122 U.S. markets. The distribution of implant/flap ratio varied by market, ranging from 5th percentile at 1.63 to 95th percentile at 43.7 (median 6.19). Modeling the implant/flap ratio vs. implant payment showed a more elastic quadratic equation ($f(x)=0.955x^2 + 2.766x$) compared to the function for flap/implant ratio vs. flap payment ($f(x)=-0.061x^2 + 0.734x$). Probability modeling demonstrated that switching the reconstructive method from implants to flaps with 0.75 probability required a $1,610 payment increase, while switching from flaps to implants at the same certainty occurred at a loss of $960.

Conclusion—There was a correlation between the ratio of flaps/implants and physician reimbursement by market. Switching from implants to flaps required large surgeon payment

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increases. Despite a revenue value unit schedule over twice as high for flaps, current flap reimbursements do not appear commensurate with physician effort.

Introduction

Breast cancer remains the most common malignancy in United States (U.S) women with 246,000 cases diagnosed in 2016 (1). Thirty-seven to forty percent of these women will undergo mastectomy(2) with upwards of forty percent receiving reconstruction (3). Breast reconstruction has steadily increased in the U.S. over the past two decades following passage of the Women's Health & Cancer Rights Act (WHCRA) of 1998 (3) (4). Techniques for reconstruction have evolved somewhat since passage of the WHCRA, but still fundamentally fall into two categories: flaps (i.e. using a patient's native, autologous soft tissue) and implants (i.e. internal prostheses). Though initial quality metrics revolved around surgeon opinion, analyses have increasingly focused on the member of the health system to whom outcomes matter the most—the patient. This idea has become paramount as patient-reported outcomes are increasingly recognized as the standard metric in national quality reporting and a focus of investigation at PCORI (Patient-Centered Outcomes Research Institute). For breast reconstruction, longitudinal data evaluating patient reported outcomes using the Breast-Q(5,6)—demonstrate that flap-based reconstructions are associated with greater long-term satisfaction compared to implants (7–9). Following the adage, "replace like with like," reconstructing the breast is best performed using a patient's own tissue compared to a saline or silicone prosthesis.

Despite this knowledge, implant reconstruction has outpaced flaps in the past decade to become the dominant reconstructive method (3)(10)(11). In a healthcare climate steering towards value, the incremental quality gains from flaps would seemingly promote this surgery, at least as frequently as implant-based reconstruction; however, the slower relative growth of flaps has not been adequately explained. One proposed barrier is physician reimbursement(10). Flap transfer is significantly more labor-intensive than implant methods, both in terms of operative time and effort during the surgery itself (12). As part of shared decision-making, surgeons and patients pursue the operation in the patient's best interests, but at some remuneration threshold, the opportunity cost of providing flap-based reconstruction could persuade surgeons to consider the alternative method.

Measuring the effects of payment variation between markets within the U.S. has the opportunity to assess whether the reconstructive method is associated with particular reimbursement values. The study aim is to: 1) determine whether variation exists in the frequency of breast reconstructive method between markets, 2) determine whether physician payment variation exists between markets, and 3) if these variations exist, determine whether they correlate with a particular reconstructive method. We hypothesize that physician reimbursement disparities exist between the reconstructive methods, creating a relative barrier for flap-based breast reconstruction.

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Methods

Using the Blue Health Intelligence (BHI, Blue Cross/Blue Shield) database (13), patient claims with a first service date falling between 1/1/2009 and 12/31/2013 were identified by Current Procedural Terminology (CPT) codes: 19357 for tissue expander implants (referred herein as “implants”) and 19364 for free autologous tissue transfers (referred herein as “flaps”). Direct to implant prosthetic reconstructions were not included. There was no distinction for whether reconstruction occurred immediately following mastectomy or was performed in delayed fashion. The date range was chosen as the most recent years of complete data within the BHI database.

Of importance were the accompanying payments made to physicians for the reconstructive surgery. Appreciating that incremental payments for bilateral surgery are less than twice the unilateral reimbursement, payments for bilateral cases were adjusted on an actuarial multiplicative factor based on the entire market pool over the five-year period. This allowed equitable comparisons at the level of a unilateral case. Bilateral cases were identified with CPT modifier “50.” Bilateral implant payments were adjusted to 61.9% of the reported value, while bilateral flap payments were adjusted 76.0% of the reported value. Stratifying the claims over the five affected calendar years (2009–2013), we were able to analyze the trends of these procedures with respect to both volume and physician payments. Dollar amounts were all adjusted for inflation using the Consumer Price Index to yield a common currency in 2013 US Dollars(14).

As a normalization process, it was deemed more appropriate to view the ratios of implants to flap procedures performed as opposed to the absolute number of either procedure type. Individual markets represented by the Metropolitan Statistical Areas (MSA), where the procedures were rendered, grouped these ratios. Outlier markets were excluded if either reconstructive method or physician payments were greater than five standard deviations from the mean. This translated into excluding markets with <10 implants and <5 flaps performed; for payments, the absolute value of reimbursement difference must have been < $1,321 for implants and <$3,313 for flaps. Sixty-one of 122 markets were included. These groupings allowed for quadratic modeling to observe the dependency of growth or decline of these ratios to the average dollar amount paid to physicians. An intercept of zero was assumed to establish the basis that no change in payment will induce no change in procedure ratio.

To determine a threshold payment range that would cause a change in procedure, a stochastic method was utilized to answer the question, “what procedure would a patient receive under the clinical and financial environment prevalent during the early period (2009–2010) versus that during the later period (2012–2013)?” A sample of 1,000 patients was randomly selected from the pool of early-period patients. To each of those sampled patients, a theoretical twin was matched such that this twin was an actual patient during the later period with the following attributes: 1) the patient age was within a span of two years plus or minus (e.g. if patient age = 50, twin’s age must be between 48 and 52 inclusive), and 2) service was rendered in the same U.S. Census Division (9 in total across the US). A total of 100 trials, with each trial resampling the source data five times, were performed. With the

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progression of each new trial, metrics showing which patients maintained the same procedure and which switched were calculated and presented as probability from 0.0 to 1.0. The asymptotic convergence toward the threshold levels for all four scenarios was observed and presented assuming that the underlying behavior follows a normal distribution.

Geographic mapping was created using Tableau (Tableau Software Inc. Seattle, Washington, USA). The distributional turnip plot was created with Stata 14.2 (StataCorp LLC, College Station, Texas, USA). Quadratic modeling and bootstrap sampling was performed in Excel (Microsoft Corp. Seattle, Washington, USA) using Macros commands.

Results

There were 21,259 episodes of breast reconstruction in the five-year period with 89.9% of women receiving implants. There was growth in the yearly incidence of both forms of breast reconstruction over the five-year period with implants increasing by 37.0% and flaps increasing by 5.2%; implants outpaced flaps by an implant/flap ratio increase of 30.3%. Trending payments over the five-year period demonstrated that total mean adjusted reimbursements increased for tissue expanders by 6.5%, while flap payments decreased by 1.8%.

There were 122 unique markets, spanning 41 U.S. states and the District of Columbia. Looking at the distribution in ratio of implants to flaps, the markets showed considerable variation, ranging from the 5^{th} percentile at 1.63 to the 95^{th} percentile at 43.7 (five markets performed no flaps). A geographic plot of the markets (collapsing all years) showed higher density of markets in the southern and eastern portions of the US. Market size (represented by circumference of circle) varied across the U.S. without any clear clustering. The ratio of implant to flap within each market (represented by color gradient) also varied across the U.S. without any clear correlation to geographic location or market size (Figure 1).

Looking at the distribution of physician reimbursements per procedure demonstrated differences (Figure 2). Mean adjusted flap reimbursement was $3,831 per case with an adjusted median of $2,239 ($25^{th}$ percentile $1,569, 75^{th} percentile $3,812). Adjusted mean implant reimbursement was $2,326 per case with an adjusted median of $2,152 ($25^{th}$ $1,670, 75^{th} $2,657). Reimbursements were thus more skewed for flaps.

Comparing the ratio of implants/flaps with physician reimbursement showed the propensity to reimburse for a particular reconstructive method. Evaluating the ratio of implants/flaps based on gains in implant payments showed a steeper quadratic equation compared to the inverse relationship (flaps/implants versus flap payment gains) as demonstrated in Figure 3. This pattern suggested markets were more elastic to payment changes for implants compared to flaps.

Finally, modeling the changes in physician reimbursement and reconstructive method between the early (2009–2010) and late (2012–2013) periods approximated the probability of a patient undergoing the alternative reconstructive method based on changes in physician payments. The four permutations (i.e. flap to implant; flap to flap; implant to implant; implant to flap) were plotted as probabilities against changes in physician payments (Figure

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4). For patients that underwent flap reconstruction in the early period, matched patients in the late period would have still undergone flap surgery with 0.75 probability at a physician payment increase of $340. For that same flap patient, switching to an implant with 0.75 probability occurred at a physician payment loss of $960. For patients that underwent implant reconstruction in the early period, matched patients in the late period would have still received an implant with 0.5 probability at a physician payment increase of $121. In order to get a 0.25 probability of switching patients from implants to flaps, physician payments would have needed to increase by $880. A higher 0.75 probability required physician payment increases of nearly $1,610. The probability range showed the largest delta for continuing flaps ($1,220) and the smallest delta for continuing implants ($70).

Discussion

Summary of findings

Similar to previous reports (15), growth of implants outpaced flaps in the five-year period of this dataset. Accordingly, the average dollars paid to surgeons for implants outpaced flaps. Inter-market variation in frequency of breast reconstructive method confirmed aim one of this study, with a distribution skewed towards a high ratio of implants in almost all markets (Figure 1). There was also notable variation in reimbursements for breast reconstruction between markets, confirming the second aim (Figure 2). Implants had a much tighter and more symmetrical distribution around the median compared to flaps where payments were skewed towards higher values. The third aim was verified based on analysis of market data on reconstructive method and physician payments (Figure 3). Increasing physician payments for either flaps or implants was associated with driving that particular reconstructive method. However, there was a notable difference in the elasticity of reconstructive method, such that small changes in physician reimbursement impacted implant volume more so than flaps. In contrast, relatively greater changes in physician payment were needed to increase the proportion of flaps performed in a market.

Finally, a similar trend was exposed when modeling the probability of reconstructive method based on payment changes over time (Figure 4). The probability of surgeons continuing to perform implant-based reconstructions remained high with minimal increases payment. Moreover, decreases in payments for flaps were associated with a high probability of substituting this technique for implants. In contrast, larger increases in payments for flap services were needed to switch from implants to flaps.

Variation and Preference-sensitive Surgery

Regional variation in surgical procedure rates is explained by multiple aspects of healthcare delivery and the external environment. On the one hand, there are conditions that universally require surgery, such as hip fracture, with variation based mainly upon the demographics of the population as opposed to differences in the health system or surgeon factors(16). On the other hand, preference-sensitive conditions do not uniformly result in one procedure, leading to fluctuations in the quantity and type of surgical care delivered. In these situations, such as for early stage prostate cancer, treatments ranging from radiation to surgery are

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oncologically equivalent with the ultimate choice varying based on provider (e.g. urologist versus radiation oncologist) and patient preference.

Breast reconstruction sits at the pinnacle of preference-sensitive surgery. Not only is the choice between implant and flap reconstruction preference-sensitive, the mere decision to undergo reconstruction at all is decided by patients along with their providers (17). Unlike early prostate cancer whereby different types of physicians provide alternative therapies, the singular reconstructive surgeon performs *both* competing surgical alternatives (i.e. implants and flaps). All things being equal, reconstructive surgeons should offer either surgery without bias, such that any variation would be associated with patient preferences and demographics (e.g. elevated BMI is a requisite for flap reconstruction). The current analysis demonstrated variation in reimbursements across markets whereby reconstructive method was correlated with surgeon payment. Considering health economic theory surrounding physician behavior and reimbursements, physicians act to both maximize profits and maintain established income levels. When income falls below acceptable levels, physicians may induce demand in other profitable procedures (18). For breast reconstruction, relative declines in flap reimbursement could increase implant reconstruction as suggested by our model. Although the absolute reimbursement for flaps stands above implants, the relative reimbursement, considering operative time and labor, may be perceived as less (19). Indirect evidence suggests that lower surgeon reimbursement (in the form of Medicaid dollars) is associated with greater use of implants compared to flap-based reconstructions(20). Our analysis substantiates these findings.

Reimbursing Labor vs. Best Practices

Other investigations modeling the effects of reimbursement on preference-sensitive procedures include literature from obstetrics and breast oncology. In a similar scenario, obstetricians provide both procedures for birth, namely vaginal and cesarean delivery. Similar to our analysis, Gruber et all(21) modeled the effects of reimbursement variation on the frequency of cesarean-section births compared to vaginal births. They found that the proportion of cesarean-section births was positively correlated with physician reimbursement, such that cesarean-section birth was more likely when physicians were paid more. This trend was confirmed, albeit to a lesser degree, in follow-up modeling(22). Similarly in breast oncology, Hadley et al(23) evaluated the effects of physician reimbursement on surgical management of early stage breast cancer. They found that greater reimbursement for mastectomy over breast conservation led to a higher likelihood of mastectomy. While both operations are oncologically equivalent, breast conservation may be considered a “best practice” based upon its lower complication rates, less invasive nature, and the ability to preserve the natural breast (24).

Minimally invasive surgery is another subgroup of preference-sensitive procedures that serve as a useful point for comparison. For example, reimbursement schemes based on current revenue value units (RVUs) appropriately reward more for cholecystectomy when performed through a labor intense laparotomy incision (25) than through laparoscopic means; however, all things being equal there is no reward for performing the operation with lower complication rates and more expeditious recovery (i.e. laparoscopic). Concisely articulated by Fader et al (25), *RVUs were created to reimburse labor; they were not developed with the intention of rewarding best practices.* While reimbursement should reflect physician labor, payment models should also incorporate whether patients receive the best operation for their problem and the associated outcomes.

Policy Adjustments to Support Flap-based Breast Reconstruction

For flap-based breast reconstruction, current RVUs may not adequately reflect the involved labor, relative to implants, nor reward it as the operation associated with greater patient-reported outcomes. From a labor standpoint, the reimbursement per hour of surgery is nearly 3–6 times higher for implants than flaps (12). Thus, current reimbursement schemes indirectly reward the operation with lower long-term patient reported outcomes. Granted, the current analysis is based on a private claims database; commercial payer rates generally reflect Medicare fee schedules(26). Evaluating RVU schedules over the past decade(27), flap-based reconstruction last underwent an adjustment in 2010 from 42.40 to 42.58. In comparison, implant-based reconstruction underwent a negative adjustment in 2011 from 21.07 to 18.50. Despite the increasing complexity of flap-based reconstruction in the past decade (i.e. perforator flaps), there has been no appreciable gain in RVUs. Interestingly, reimbursements for implants continue to rise despite the negative RVU adjustment, perhaps reflecting the greater nationwide demand for breast reconstruction overall.

Based on these findings, consideration could be given to adjusting RVUs for flap-based breast reconstruction along with a means of incentivizing quality. By way of example, the American College of Surgeons and National Cancer Database have established breast conservation as a quality metric for early stage breast cancer (28). An equivalent reporting metric could be considered in breast reconstruction whereby the proportion of women eligible (e.g. no prior abdominal surgery and elevated BMI) for flaps who receive this reconstructive method is measured. A more modern health policy solution would be a value based care model, wherein both methods of reconstruction are bundled together with an episode period that captures the long-term rewards associated with flaps.

Limitations

Given breast reconstruction is a preference-sensitive condition, patient demographics and opinion could contribute to operative determinations, which could alter the strength in association of payment and reconstructive method. While this study accounted for age, it did not account for other variables associated with implant-based reconstruction such as lower BMI (body mass index), which is associated with implant reconstruction (3)(11). The BHI database does not include this information. Additionally, this analysis also does not consider instrumental variables such as the distribution of reconstructive surgeons across the US, although our inclusion criteria for modeling payment changes was focused on markets with sufficient autologous reconstruction.

The current study also did not differentiate immediate versus delayed reconstruction, or salvage of failed primary reconstructions. Because delayed and salvage reconstructions often employ autologous tissues, this may introduce a potential bias; however, immediate reconstructions proportionally represent the overwhelming majority of US breast

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reconstructions. Whether or not this effect skews physician's preference for a primary breast reconstruction method cannot be determined with the analysis.

Additionally, this study did not examine the impact of secondary (i.e. revisionary) procedures and surgeon decision-making. Revisionary surgery following primary reconstruction is common for both autologous tissue and implants. The largest longitudinal study to date (29) demonstrated that 76.2% of implant and 47.8% of autologous reconstructions underwent at least one secondary breast procedure within three years. Assuming comparable revision rates in the current cohort, there would be greater opportunity for additional revenue streams for surgeons who provide implant reconstruction. The current model would therefore underestimate the financial disparity between implant and autologous reconstruction. Lastly, the influence of physician payment on direct to implant breast reconstruction was not evaluated herein. Although beyond the scope of this study, this format of reconstruction has additional economic incentives that require exploration.

This study is based on a single commercial insurance payer and does not have the ability to incorporate the effects of multiple payers on markets (18). There is evidence that in markets with only one commercial payer and Medicare, some degree of cost-shifting may occur when either payer lowers its payments (30). Understanding the impact of payer mix in markets could help assess the strength of our results and could be considered for future analysis. That said, our study analyzes differences in breast reconstruction within markets understanding that the surgeons in these markets would be performing both types of operations. Thus any effects from payer mix should be evenly distributed. Regarding our interpretation of market forces inducing surgeon preference for performing an operation, we acknowledge the limitations of applying neo-classical economic theory to healthcare markets(31). Third-party payers influence reimbursements, and intercede patients (demand) and surgeons (supply). This study showed a correlation between physician reimbursement and the likelihood of performing an operation, without implicating causality. Elements of patient demand and physician preference likely both contribute to this observation.

For the bootstrapping, a normal distribution was assumed to dictate the payment patterns and the resulting 25%/75% ranges; however, given this sample is hypothetical, the actual distribution cannot truly be known and may follow another Bayesian distribution.

Conclusion

Market-based analysis of breast reconstruction showed variation in method and physician reimbursement across the United States. Compared to flaps, markets were relatively more elastic to changes in implant reimbursements. Probability modeling demonstrated high certainty of surgeons switching from flaps to implants even at relative payment losses. In contrast, large payment increases would be needed to encourage surgeons to continue performing flaps or to switch from implants to flaps. The current findings suggest that insufficient physician reimbursement relative to effort may influence rates of preference sensitive procedures including flap-based breast reconstruction. Given their superior long-

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term patient-reported outcomes, policy changes are suggested to facilitate flap-based reconstruction.

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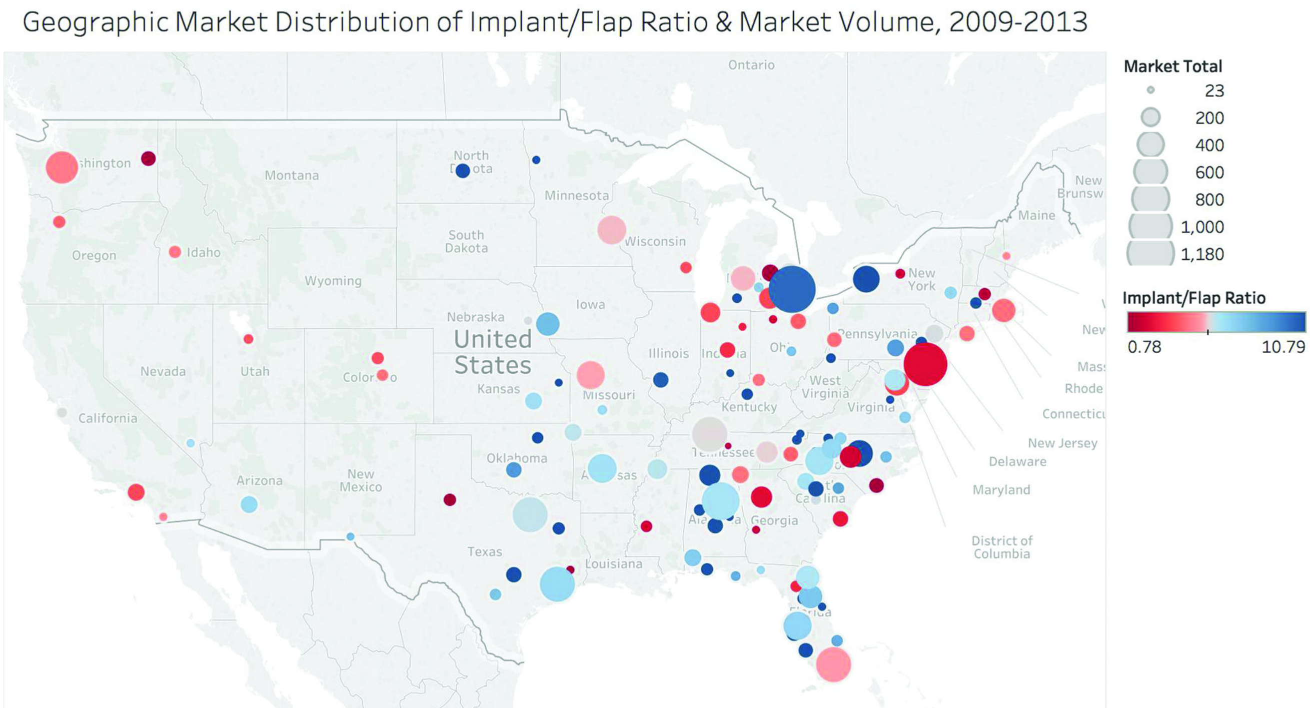

Figure 1.
Distribution of 122 markets by zip code. Circumference of each circle represents the total volume of breast reconstruction performed in each market between 2009–2013. The color of each circle denotes the ratio of implants to flaps within that market. The color spectrum is centered on the densest three quartiles of implant to flap ratio in order to show differences. Blue denotes a higher ratio of implants to flaps, while red denotes a lower ratio of implants to flaps (i.e. relatively more flaps).

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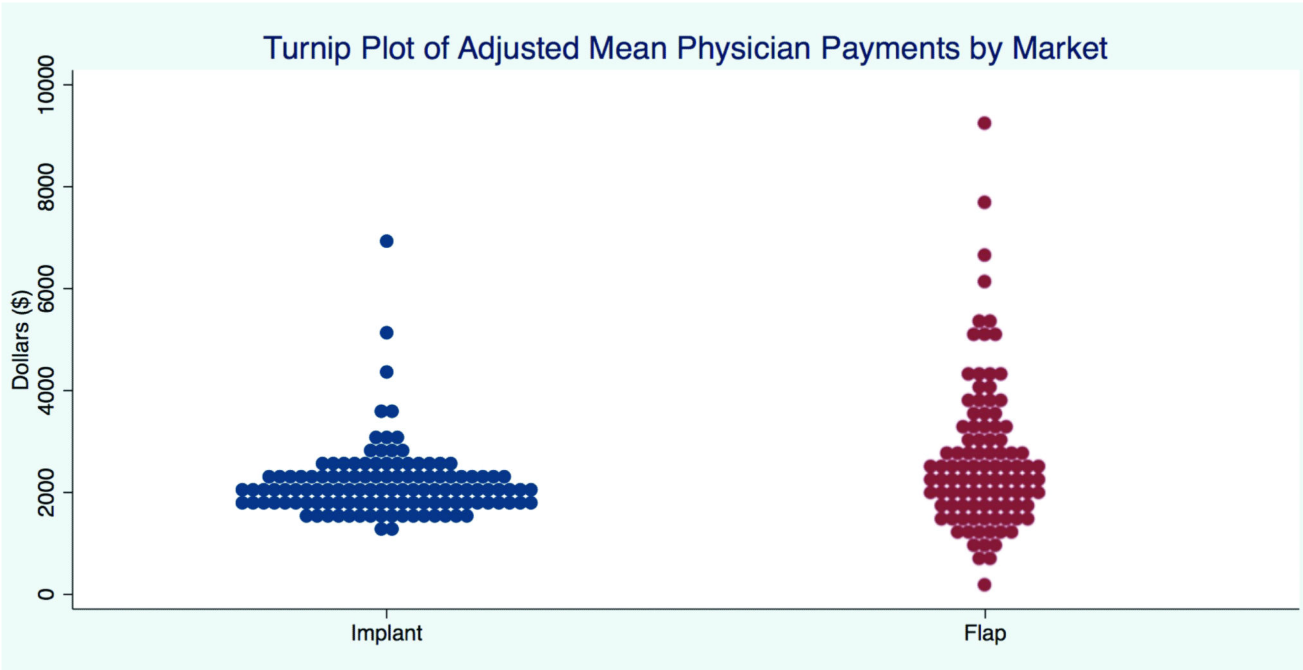

Figure 2.
Turnip plot demonstrating the distribution of mean physician payments by 122 U.S. markets in the BHI database. Implants and flaps are shown in blue and red respectively. Each dot represents a single market. There is greater variance and skew in flap payments compared to the tighter clustering for implant payments.

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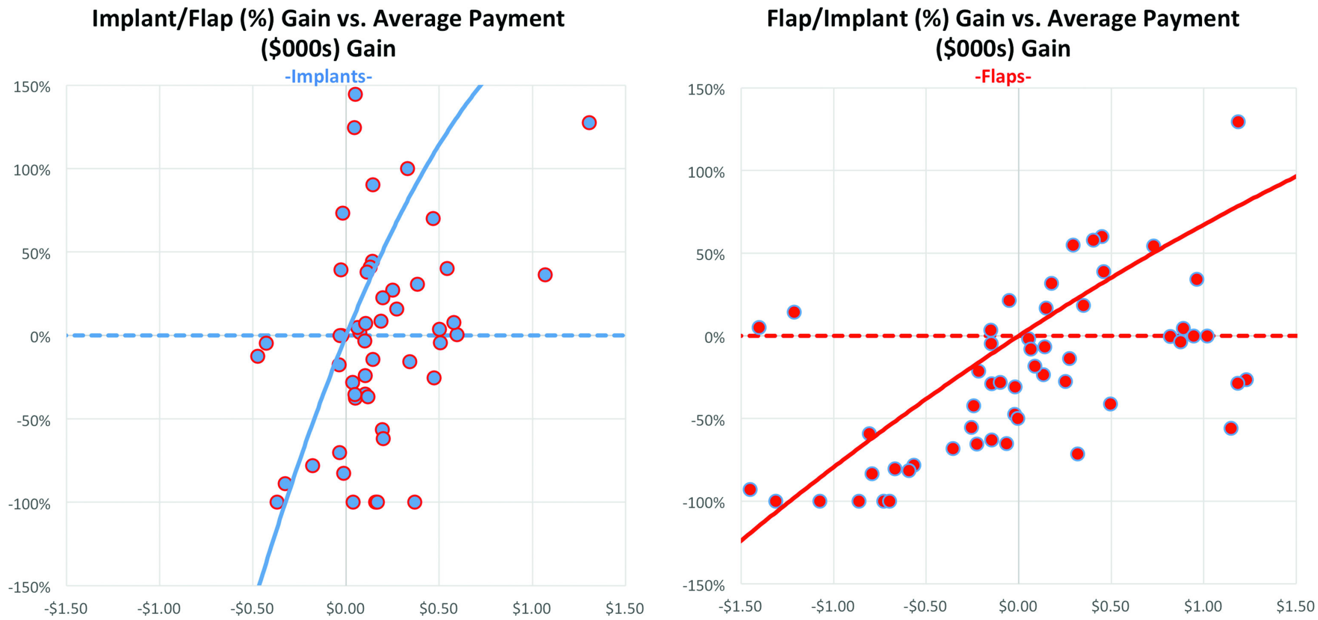

Figure 3.

Scatterplot demonstrating the relationship between the ratio of surgical method and the average difference in physician payments between markets. Each dot represents an individual market. An intercept of zero was assumed to establish the basis that no change in payment will induce no change in procedure ratio. The function for implant/flap gain to average implant payment gain was $f(x)=-0.955x^2 + 2.766x$. The function for flap/implant gain to average flap payment gain was $f(x)=-0.0608x^2 + 0.734x$. The steeper function for implant/flap ratio on the left plot suggests greater market elasticity for performing implants compared to flaps.

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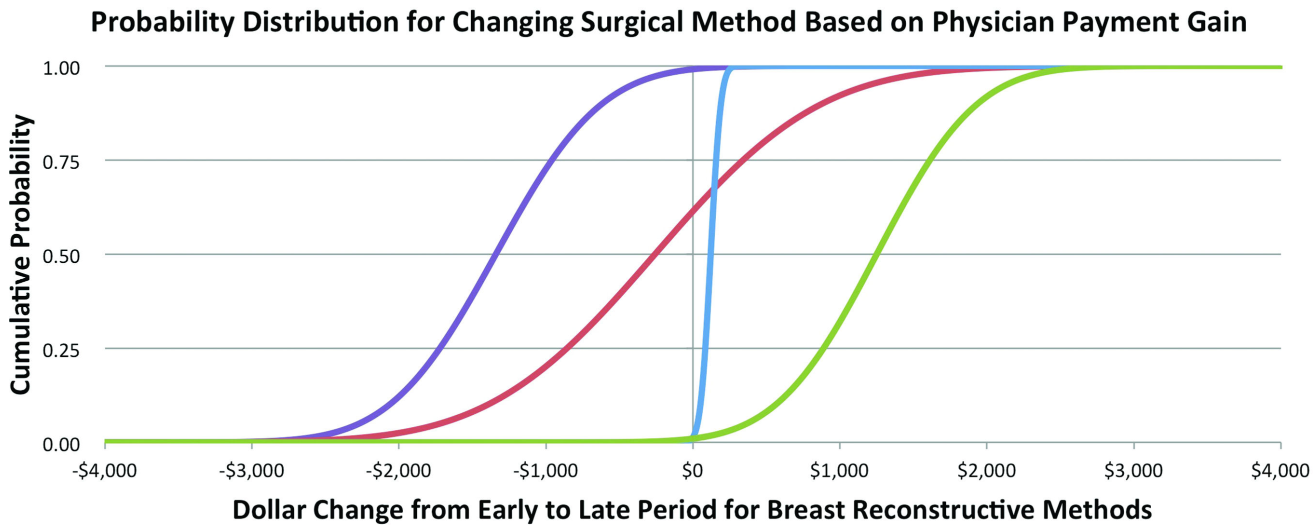

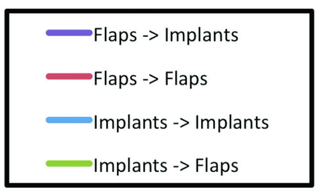

	Quartiles for probability of changing surgical method with physician payment gains			0.25-0.75 Range
	0.25	0.50	0.75	
Flap -> Implant	-$1,730	-$1,340	-$960	$770
Flap -> Flap	-$860	-$258	$340	$1,200
Implant -> Implant	$80	$121	$150	$70
Implant -> Flap	$880	$1,250	$1,610	$730

Figure 4.
Bootstrap simulation for matching patients from the early study period (2009–2010) and late period (2012–2013). Subjects were matched on U.S. census division and age. Bootstrap sampling with replacement extracted 1,000 matches each cycle for 500 cycles. Curves represent the probabilities of patients continuing with their original reconstructive method or changing to the alternative method based on differences in the frequencies of reconstructive method and payments between the two periods. The four permutations are shown in four different colors. Probability range quartiles with corresponding payment changes are given for reference.