



Original article

A comparison of patient-centered economic and clinical outcomes of post-mastectomy breast reconstruction between obese and non-obese patients



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ABSTRACT

Background: The objectives of this study were to compare, by patient obesity status, the contemporary utilization patterns of different reconstruction surgery types, understand postoperative complication profiles in the community setting, and analyze the financial impact on health care payers and patients. **Methods:** Using data from the MarketScan Health Risk Assessment Database and Commercial Claims and Encounters Database, we identified breast cancer patients who received breast reconstruction surgery following mastectomy between 2009 and 2012. The Cochran-Armitage test was used to evaluate the utilization pattern of breast reconstruction surgery. Multivariable logistic regressions were used to estimate the association between obesity status and infectious, wound, and perfusion complications within one year of surgery. A generalized linear model was used to compare total, complication-related, and out-of-pocket costs.

Results: The rate of TE/implant-based reconstruction increased significantly for non-obese patients but not for obese patients during the years analyzed, whereas autologous reconstruction decreased for both patient groups. Obesity was associated with higher odds of infectious, wound, and perfusion complications after TE/implant-based reconstruction, and higher odds of perfusion complications after autologous reconstruction. The adjusted total healthcare costs and out-of-pocket costs were similar for obese and non-obese patients for either type of breast reconstruction surgery.

Conclusions: A greater likelihood of one-year complications arose from TE/implant-based vs autologous reconstruction surgery in obese patients. Given that out-of-pocket costs were independent of the type of reconstruction, greater emphasis should be placed on conveying the surgery-related complications to obese patients to aid in patient-based decision making with their plastic surgeons and oncologists.

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Introduction

Breast cancer is the most common malignancy in women, with an estimated 231,840 new cases diagnosed in the United States in 2015 [1]. Mastectomy, the standard of care before the

1980s, remains one of the most widely used breast cancer treatments today. Despite numerous studies documenting the equal effectiveness in cancer control between mastectomy and radiation therapy following breast conserving surgeries [2,3], an upward trend of mastectomy has been observed in the past decade [4,5]. Patients with breast cancer who choose to undergo breast reconstruction after mastectomy have the option between two techniques of breast reconstruction: autologous vs. implant-based reconstruction [6,7]. Each form of reconstruction has its distinctive advantages and disadvantages, making the selection process complex for patients, plastic surgeons, and oncologists.

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Studies in the U.S. have shown an increasing use of breast reconstruction surgery following the Women's Health and Cancer Rights Act of 1998, which was designed to remove the financial burden associated with reconstruction for breast cancer patients [8,9]. Two epidemiological trends suggest that obese patients will constitute a substantial proportion of breast reconstruction surgeries: a prevalent obesity rate of adult women in the U.S. as high as 36.5% [10] and a demonstrated association between obesity and increased risk of breast cancer in postmenopausal women [11–13]. While previous research has shown that patients with obesity experienced higher rates of complications with either autologous or implant-based reconstruction, information from the current literature is of limited use to breast cancer patients because of the relatively short duration of observations (i.e. 30 days) in these studies [14–20]. For many patients, information on intermediate- or long-term complications is equally, if not more, important than 30-day perioperative complications because patients need to factor in the long-lasting effects when selecting between different forms of breast reconstruction.

Another important factor for patients contemplating different methods of breast reconstruction is cost. Very few studies have evaluated costs of breast reconstruction and the associated post-operative complications. Further, most of these studies reported costs using service charge data obtained from university-affiliated hospitals [15,21–23]. Costs reported from these studies are of less relevance to patients because charges tend to be highly inflated. More importantly, none of the existing studies have estimated the out-of-pocket costs of surgery and postoperative care, factors which are of critical importance to patients. Indeed, it has been reported that sixty-three percent of patients wanted to know out-of-pocket costs from their physicians [24]. In light of the limited cost information available for patients faced with the choice between different reconstruction techniques, an understanding of the economic impact of the reconstruction methods is greatly needed.

In the present study we sought to characterize the type of reconstructive surgery with less risk and cost to obese patients to be able to guide treatment choice for this high-risk patient population. We started by describing the contemporary trend toward use of autologous reconstruction and TE/implant-based reconstruction for obese and non-obese patients, followed by examining the subsequent complications incurred within one year of undergoing each type of breast reconstruction. We then estimated and compared total, complication-related, and out-of-pocket costs between obese and non-obese patients.

Patients and methods

Datasets

Unlike many countries in the Organization for Economic Cooperation and Development (OECD), the United States doesn't have a single-payer health care system. Americans aged 65 and older as well as younger people with disabilities are covered by Medicare, an insurance program administered by US federal government. For most individuals younger than 65 with income above poverty level, they often obtain health insurance from their employers. MarketScan databases, data used in our study, were based on information collected from employment-based insurance. The MarketScan Health Risk Assessment (HRA) and Commercial Claims and Encounters (CC&E) databases (Truven Health Analytics, Ann Arbor, MI). The MarketScan HRA database includes self-reported information on biometrics, health status, health risks and behavioral change collected from risk assessment questionnaires of employees administrated by participating U.S. corporations and health plans. The MarketScan CC&E database is a large de-identified

health care claims database of civilian working populations, their spouses, and dependents in the United States [25]. The MarketScan HRA covers approximately 2% of enrollees from the MarketScan CC&E, and it can be linked with the CC&E via a unique identifier for each enrollee. This study was granted an exemption from review by the institutional review board at The University of Texas MD Anderson Cancer Center for use of de-identified data.

Ascertainment of study cohort

From the linked databases, we identified patients aged less than 65 years old and diagnosed with breast cancer (International Classification of Diseases, 9th revision [ICD-9] codes 174.XX) who had undergone mastectomy between January 1, 2009 and December 31, 2012. The date of mastectomy was considered the index date. We included patients who had at least two diagnosis codes on separate dates for breast cancer within 3 months of the index date. To ensure data completeness, we only included patients who had continuous medical insurance coverage for the duration from 3 months before to 12 months after the indexed mastectomy. To improve the specificity of the cohort, we excluded patients who had undergone radiation therapy within 3 months before mastectomy and those who had a diagnosis code of metastatic disease during the study period. To study the one-year complications after breast reconstruction surgery, we further limited the study sample to patients who had 12 months of continuous medical insurance coverage after breast reconstruction to ensure completeness of information in the one-year observational window. The cohort ascertainment criteria are summarized in [Appendix Material A](#). The final sample consisted of 1780 patients who had received either autologous or TE/implant-based reconstruction after mastectomy and who also satisfied the aforementioned criteria.

Identification of breast reconstruction

We used ICD-9 procedure codes and Healthcare Common Procedure Coding System (HCPCS) codes to identify autologous (transverse rectus abdominis myocutaneous flap, deep inferior epigastric artery perforator flap, superficial inferior epigastric artery flap, gluteal artery perforator flap, latissimus dorsi flap, and other free flap) or TE/implant-based reconstruction procedures that had been performed within one year after mastectomy ([Appendix Material B](#)). We applied the intent-to-treat approach and categorized patients who had received both autologous reconstruction and TE/implant-based reconstruction within the one-year study period according to the type of the first reconstruction procedure received after mastectomy.

Obesity status and other key variables

The primary independent variable of interest was BMI, which was reported as a continuous variable in the HRA database. Based on the World Health Organization (WHO) obesity classification system, we dichotomized this BMI variable as non-obese ($\text{BMI} \leq 29.9 \text{ kg/m}^2$) versus obese ($\text{BMI} \geq 30 \text{ kg/m}^2$) [26].

Other demographic and clinical variables included age at mastectomy, metropolitan statistical area (MSA), census region, insurance type, comorbid conditions, bilateral mastectomy, breast cancer lymph node surgery, chemotherapy, and radiation therapy ([Table 1](#)). We classified patients' breast reconstructions as immediate reconstruction if the reconstruction code was recorded on the same day as the mastectomy and as delayed reconstruction if the reconstruction code was recorded after the date of mastectomy. To capture the burden of comorbid conditions, we identified four common risk factors of surgical complications reported in the

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