

## Original article

# A cost-utility analysis comparing large volume displacement oncoplastic surgery to mastectomy with single stage implant reconstruction in the treatment of breast cancer



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## ABSTRACT

**Background:** For larger cancers in moderate to large breast sized women, breast surgical cancer treatment may include large volume displacement oncoplastic surgery (LVOS) or mastectomy with single stage implant reconstruction (SSIR). Often in the case of LVOS, reduction mammoplasty designs are used in the oncoplastic reconstructions with a contralateral symmetry operation. The goal of this study was to investigate the cost-utility between LVOS versus SSIR to determine which approach is cost-effective in the treatment of breast cancer.

**Methods:** A review of the literature was performed to determine baseline values and ranges. An average national Medicare payment rates using DRG and CPT codes were used for cost assessment. After constructing a decision tree, an incremental cost-utility ratio (ICUR) was calculated comparing the difference for both surgical options in costs by the difference in clinical-effectiveness. To validate our results, we performed one-way sensitivity analyses in addition to a Monte-Carlo analysis.

**Results:** An ICUR of \$546.81/QALY favoring LVOS was calculated based off of its clinical-effectiveness gain of 7.67 QALY at an additional cost of \$4194. One-way sensitivity analyses underscored the degree by which LVOS was cost-effective. For example, LVOS became cost-ineffective when a successful LVOS cost more than \$50,000. Similarly, probabilistic sensitivity analysis using Monte-Carlo simulation showed that even with varying multiple variables at once, results tended to favor our conclusion supporting the cost-effectiveness of LVOS.

**Conclusions:** For the appropriate patients with moderate to large sized breasts with breast cancer, large volume displacement oncoplastic surgery is cost-effective compared to mastectomy with single staged implant reconstruction.

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## Introduction

The indications for breast conservation have increased with the adoption of oncoplastic surgery. In the past, presentation of breast cancer patient that would have been relegated to mastectomy can now possibly entertain the notion of breast conservation especially using reduction mammoplasty or mastopexy oncoplastic techniques. The choice between performing oncoplastic surgery versus

mastectomy and reconstruction is complex but breast cancer patient with larger sized tumors in large or ptotic breasts may be counseled for either choice. As such, each treatment option varies with regards to clinical outcomes, such as positive margin rates [1,2] and postoperative complication rates [3,4]. Additionally, there is no difference in long-term survival in patients undergoing mastectomy with reconstruction versus breast conservation using oncoplastic surgery [5,6]. An aesthetic advantage in women who undergo breast conserving surgery especially with oncoplastic surgery is that they have less breast asymmetry, less adhesions to chest wall, and patients generally feel more comfortable with their

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bodies and the overall psychosocial well-being [7,8]. However, even with large volume displacement oncoplastic surgery (Level II oncoplastic surgery), concerns exist regarding the positive margin rate [9,10]. Due to the multitude of operative outcomes between these two operative choices, with each option having certain advantages and associated costs over the other, our goal was to perform a cost-utility study comparing large volume displacement oncoplastic surgery to mastectomy with single stage implant reconstruction in the breast cancer patient eligible for both options. To our knowledge, scarce data exists cost-effectiveness data exists evaluating oncoplastic surgery, and there has been no cost-effectiveness study comparing these two surgical modalities [11].

**Methods**

*Reference case*

For decision analysis, we defined a base case as a 45-year-old female patient with an early stage 3.0 cm invasive breast cancer. While a range of breast sizes (moderate to large) and breast ptosis (grade II to III) could be treated with either surgical option, our base case is assumed to be moderately sized with grade II ptosis. Such a patient is eligible for both large volume displacement oncoplastic surgery (LVOS) as well as mastectomy with single stage direct implant reconstruction (SSIR). This cohort excludes all patients with contraindications to both treatment modalities, patients with previous breast surgery or radiation therapy. Large volume oncoplastic surgery is analogous to Level II oncoplastic surgery described by Clough et al. [12].

*The decision analysis model*

To construct the model and compare the cost-effectiveness between LVOS and SSIR, we used TreeAge Software Pro version 2015 (Treeage Software, Inc., Williamstown, MA). Fig. 1 shows the decision tree. Costs, QALYs, clinical outcomes and their probabilities

were incorporated into this model comparing LVOS and SSIR as two separate arms. Patients undergoing LVOS may have successful surgery with no complications, or may experience one of the surgical complications from the original or subsequent operations. Furthermore, we have accounted for the cost of radiation therapy for patients who undergo LVOS as demonstrated in the second arm of the decision tree. Additionally, patients in the LVOS arm may have positive margins which would lead to a mastectomy with SSIR.

*Costs*

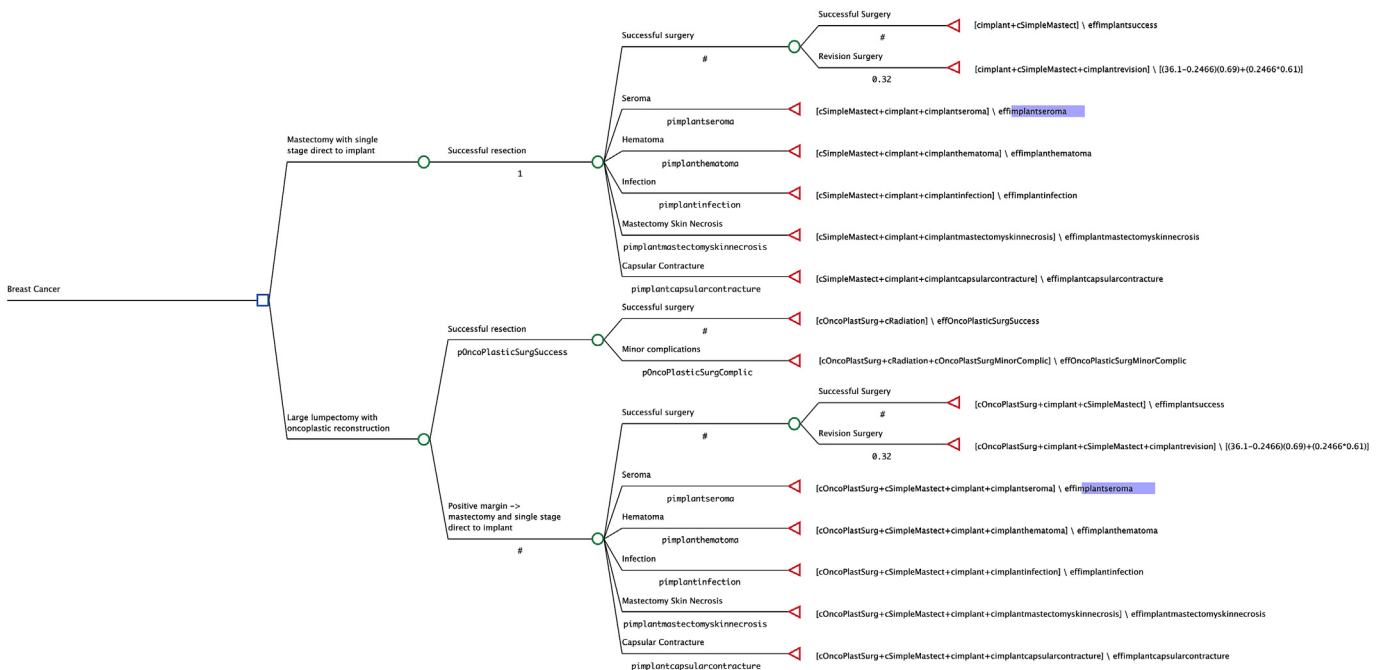
We obtained costs for each health state and clinical outcome in the decision analysis using Medicare current procedure terminology (CPT) codes and diagnosis related groups (DRG) codes. The major health states with their costs are shown in Table 1. All payment data, for surgery and radiation therapy, was based on 2016 Medicare CPT and DRG reimbursement national averages.

*Perspective*

The perspective of the third party payer was adopted for the decision analysis. This is a well established perspective that has been used in multiple empirical cost-utility studies [13–17] and provides a fair and equally balanced cost burden to each treatment option being studied.

*Probabilities*

Base-case values as well as the probabilities for each health state associated with clinical outcomes and rate of positive margins post breast conservation surgery were obtained from comprehensive literature review. This data was cross-referenced with other past literature reviews to establish consistency of health state outcomes and associated probabilities. These probabilities are noted in the decision tree.



**Fig. 1.** The decision tree model of large volume oncoplastic surgery versus mastectomy with single stage implant reconstruction and health stats associated with each treatment arm.

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