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# Analysis of Secondary Surgeries after Immediate Breast Reconstruction for Cancer Compared with Risk Reduction

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**Background:** This study sets out to compare reconstructive practice between patients undergoing immediate breast reconstruction (IBR) for cancer and those who opted for risk reduction (RR), with an emphasis on examining patterns of secondary surgery.
**Methods:** Data collection was performed for patients undergoing mastectomy and IBR at a teaching hospital breast unit (2013–2016).
**Results:** In total, 299 patients underwent IBR (76% cancer versus 24% RR). Implant-based IBR rate was similar in both groups (58% cancer versus 63% RR). Reconstruction loss (5.3% cancer versus 4.2% RR) and complication (16% cancer versus 12.9% RR) rates were similar. Cancer patients were more likely to undergo secondary surgery (68.4% versus 56.3%; $P = 0.025$), including contralateral symmetrization (22.8% versus 0%) and conversion to autologous reconstruction (5.7% versus 1.4%). Secondary surgeries were mostly planned for cancer patients (72% planned versus 28% unplanned), with rates unaffected by adjuvant therapies. This distribution was different in RR patients (51.3% planned versus 48.7% unplanned). The commonest secondary procedure was lipomodeling (19.7% cancer versus 23.9% RR). For cancer patients, complications resulted in a significantly higher unplanned secondary surgery rate (82.5% versus 38.8%; $P = 0.001$) than patients without complications. This was not evident in the RR patients, where complications did not lead to a significantly higher unplanned surgery rate (58.9% versus 35.2%; $P = 0.086$).
**Conclusions:** Most of the secondary surgeries were planned for cancer patients. However, complications led to a significantly higher rate of unplanned secondary surgery. Approximately 1 in 4 RR patients received unplanned secondary surgery, which may be driven by the desire to achieve an optimal aesthetic outcome. *(Plast Reconstr Surg Glob Open 2020;8:e3312; doi: 10.1097/GOX.0000000000003312; Published online 17 December 2020.)*

## INTRODUCTION

Immediate breast reconstruction (IBR) is increasingly performed for breast cancer patients[1] as well as for patients who are deemed to have a high family history risk of developing breast cancer who undergo risk reducing (RR) mastectomy.[2] Increased utilization of BRCA mutation gene testing has resulted in more patients opting for RR mastectomy and IBR.[3] Given the different indications for mastectomy and IBR, one would expect differences in patient characteristics as well as in reconstructive practice and outcome. One may expect patients undergoing RR mastectomy and IBR to be younger in age, more likely to undergo bilateral implant-based reconstruction[4] and less likely to undergo additional surgery given the lack of adjuvant treatments required [eg, post mastectomy radiotherapy (PMRT)].[5] However, comparison studies illustrating differences in surgical practice and outcome between the two groups are sparse,[6] and this area warrants further exploration.

Some patients will opt for and benefit from secondary surgeries following their IBR.[7] These secondary surgical procedures include revisional surgeries (eg, lipomodeling) to maintain and improve the quality of IBR. Breast units in

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the UK have traditionally been able to offer patients such procedures without restriction. However, increasing number of breast units in the UK have had restrictions imposed in terms of the number of revisional operations allowed, as well as time limits to complete the patient's reconstruction (Breast Cancer Now report[8]). This is a clear concern, and studies are warranted to examine the pattern and types of secondary surgical procedures, which may be planned[9] (eg, symmetrizing surgery) or unplanned (eg, unsatisfactory cosmetic results). We hypothesized that the RR group of patients underwent less secondary surgery compared with the cancer patients. We anticipated the RR patients to undergo bilateral IBR and hence more likely to achieve symmetry at the initial surgery, whereas some of the cancer patients may benefit from subsequent contralateral symmetrizing procedures. We anticipated lower complication rates in the RR patients and, as a result, they are less likely to undergo further unplanned secondary surgical procedures. This was because RR patients are likely to be younger in age and, therefore, are less likely to have significant co-morbidities. We therefore sought to examine the pattern of secondary planned or unplanned surgical procedures following IBR in both groups of patients and sought to look for any potential differences. Additional information about which group of patients are more likely to undergo further surgery following their IBR would have clinical utility.

Leeds Breast Unit is a tertiary center treating over 700 cancer patients per year, offering a full range of IBR and secondary surgeries. We run a dedicated family history service for the region. The high volume practice and the case mix therefore facilitate the examination of these 2 patient groups.

## METHODS

This was a retrospective cohort study using a prospectively maintained electronic database (Patient Pathway Manager). All consecutive patients undergoing mastectomy and IBR for cancer and RR (2013–2016) were identified and relevant data were collected. No ethical approval for the study was required as per hospital research governance protocol. All data extracted for the study were routinely recorded on Patient Pathway Manager as part of standard clinical care. The time period was chosen to enable a minimum of 3-year follow-up time to examine patterns of secondary surgical procedures. This is especially important for cancer patients who complete their adjuvant treatments (eg, PMRT) before opting for further surgery. Furthermore, the unit incorporated pre-pectoral implant-based reconstruction in 2017. We therefore collected data on patients up to the end of 2016 to limit heterogeneity to examine patients who had sub-pectoral implant-based reconstruction. All surgeons in the unit perform mastectomy and IBR for cancer and RR, as well as subsequent secondary surgeries. With regard to our implant-based reconstruction practice, we all performed subpectoral reconstructions with textured implants or expanders with Acellular Dermal Matrix (ADM) or dermal sling usage for lower pole coverage. We do not routinely perform free nipple graft or immediate nipple reconstruction. Similarly, our unit practice is to perform contralateral symmetrization at a later date to achieve optimal symmetry. For latissimus dorsi (LD) reconstructions, all surgeons in the unit aim to perform fully autologous LD IBR and use only implants where the flap volume is insufficient to achieve optimal symmetry. Our plastic surgeons performed deep inferior epigastric perforator abdominal free flaps.

The following data were extracted: patient age, date and types of IBR, subsequent surgeries, mastectomy for cancer or RR, type of mastectomy (nipple preserving or sacrificing/wise pattern), unilateral or bilateral IBR, type of axillary surgery, expander usage, ADM usage, patient co-morbidities (smoking, diabetes, steroid use, and body mass index), mastectomy weight, type of adjuvant therapy received, loss of reconstruction at 3 months post-surgery,[10] additional surgery types, presence of complication up to 30 days after surgery,[11] and BRCA mutation status.

For the secondary surgical procedures, we categorized these procedures into planned—which was anticipated from the initial onset (eg, nipple reconstruction, contralateral symmetrization, and exchange of expander to a definitive reconstruction)—as opposed to unplanned (eg, lipomodeling due to fat necrosis after autologous reconstruction, implant exchange after initial DTI reconstruction, scar revisions, and any acute surgery for complication). Lipomodeling procedure was categorized as an unplanned secondary surgical procedure. Not all cancer patients who have direct-to-implant reconstruction require a mandatory switch to autologous reconstruction after PMRT. Therefore, this was classified as unplanned. This is as opposed to planned exchange of tissue expanders to a definitive reconstruction after PMRT. Nipple–areolar complex (NAC) tattooing was excluded because it was not deemed a surgical procedure. Patients who required further oncological surgery due to local recurrence were also excluded from the analysis.

Statistical analyses were performed using SPSS, v 26.0. Continuous variables were presented by means (SD) or medians (interquartile range). Categorical variables were presented by frequency (percentage). Independent *t*-tests were used to test for associations between continuous variables. Chi-squared tests were used to test for associations between categorical variables. In addition, uni- and multivariate regression analyses (Spearman's rho) were performed to determine the impact of adjuvant therapy (eg, PMRT) on unplanned revisional surgery. $P \leq 0.05$ was deemed to be statistically significant.

## RESULTS

In the 3-year study period, 299 consecutive patients underwent IBR (76% for cancer versus 24% for RR; median follow-up 4.8 years). An estimated 94 patients underwent bilateral IBR and, hence, a total of 393 breast reconstructions were performed. Mean age for the whole cohort was 48.1 years (50.1 years for cancer versus 41.7 years for RR; $P = 0.001$). In total, 59.2% of the whole cohort underwent implant-based IBR. Fully autologous LD reconstruction was performed in 15.1%, and implanted-assisted LD reconstruction was performed in 14.4%. deep inferior epigastric perforator flap was performed in 11.3%. Implant-based reconstruction rates were similar (58% for cancer versus 63% for RR; Fig. 1).

Bilateral mastectomy rates were 86% in RR patients as opposed to 15.5% in cancer patients. The remaining 14% of RR patients either had contralateral mastectomy and IBR after previous unilateral cancer surgery or had staged bilateral reconstructions (eg, unilateral mastectomy and LD reconstruction at different time points). For the cancer patients undergoing bilateral mastectomy, 38.7% were BRCA gene mutation positive or were categorized as high family history risk, as per the National Institute for Health and Care Excellence guidelines.[12] The remaining patients received elective bilateral mastectomy, based on the patient's treatment preference. In contrast, 91.9% of the RR patients undergoing bilateral mastectomy were BRCA gene mutation positive or had a high risk family history. Nipple-preserving skin-sparing mastectomies were more frequent in the RR group (37% versus 13.2%; $P$ = 0.002). Wise pattern skin reducing mastectomy rates were similar in both groups (18% in cancer versus 23% in RR; $P$ = 0.23). Of the cancer patients, 37.3% received chemotherapy, and 23.7% received PMRT.

Expander usage was less frequent in RR patients (17.8% versus 41%; $P$ = 0.02). This was observed despite similar ADM usage rates and skin reducing mastectomy rates in both groups (Fig. 2). An estimated 5% of patients in the entire cohort lost their reconstruction at 3 months after IBR. Reconstruction loss rate was similar in both groups (5.3% cancer versus 4.2% RR; $P$ = 0.73). Both groups of patients were comparable in terms of potential risk factors (Table 1).

In total, 65.6% of patients in the whole cohort underwent secondary surgery. As anticipated, these procedures were more frequently performed in cancer patients (68.4% versus 56.3%; $P$ = 0.025). For the whole cohort, the commonest secondary surgical procedures included lipomodeling (20.7%), nipple reconstruction (20.5%), contralateral symmetrization (17.4%), implant exchange (14%), and scar revisions (13%). For patients who underwent implant exchange, 60.6% were due to exchange of expander to implant, and 39.4% were due to replacement of the pre-existing implant. When the two groups were compared, contralateral symmetrization (22.8% versus 0%) and conversion to autologous reconstructions (5.7% versus 1.4%) were more frequent in cancer patients (Fig. 3).

The median duration between IBR and the start of secondary surgery did not differ between the 2 groups (454 days for cancer versus 446 days for RR). Furthermore, the median duration between the commencement and the date of last secondary surgery did not differ between the 2 groups (582 days for cancer versus 550 days for RR). For both the cancer and RR patients who underwent secondary surgery, they required a median of 2 secondary procedure (range 1–6).

For cancer patients who received secondary surgery, these were mostly planned (72%) and included nipple reconstruction, contralateral symmetrization, removal of remote tissue expander port, and exchange of tissue expander to a definitive reconstruction. The unplanned procedures (28%) included scar revision, lipomodeling, acute surgery for complications, conversion to another type of reconstruction or deconstruction, exchange of implant where direct to implant (DTI) reconstruction was initially performed, implant pocket adjustments, and liposuction to reshape autologous reconstruction. For RR patients, planned secondary surgeries (51.3%) were performed less frequently, with approximately 1 in 4 of the RR patient cohort receiving unplanned secondary surgery.

For cancer patients, the overall complication rate was 16%, of which 58.5% had minor complication that settled with conservative management. For the cancer cohort, patients with complication had significantly

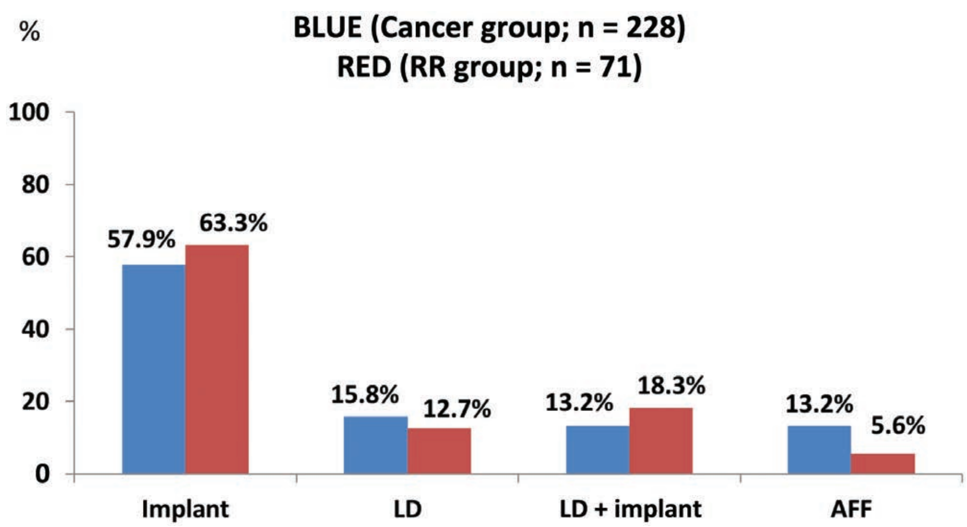


**Fig. 1.** Comparison of the type of IBR performed in cancer and RR patients. Similar rates of implant-based breast reconstructions were observed in both patient cohorts.

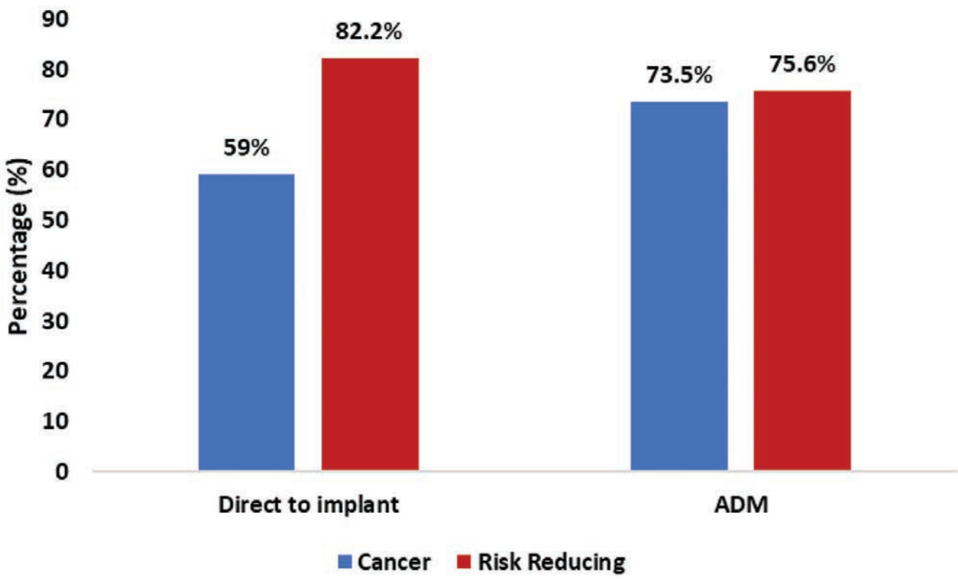


**Fig. 2.** Comparison of the type of implant-based reconstructions performed in cancer and RR patients. Expander reconstructions were less common in RR patients, despite the similar rate of ADM usage.

higher unplanned secondary surgery rate (82.5% versus 38.8%; *P* = 0.001) than patients without complication. For RR patients, the overall complication rate was similar at 12.9% (*P* = 0.413), of which 76.5% had minor complication. In the RR cohort, the presence of complication did not lead to a significantly higher unplanned surgery rate (58.9% versus 35.2%; *P* = 0.086). The types of complications as well as the pattern of subsequent secondary surgeries required are summarized in Figures 4 and 5.

To further investigate the potential impact of adjuvant therapy on unplanned surgery rate in the cancer patients, univariate regression analysis (Spearman's rho) was performed. The factors analyzed included patient age, smoking status, diabetes and steroid usage, unilateral or bilateral surgery, type of skin sparing mastectomy and axillary surgery, receipt of chemotherapy (adjuvant or neoadjuvant), and PMRT. The analysis showed that none of these factors significantly affected unplanned surgery rate (Table 2). In addition, we performed a subgroup analysis of patients who received expander reconstruction, PMRT, and conversion to autologous reconstruction.

In the whole cohort, expanders were used for 28.8% of patients who underwent an implant-based IBR. As expected, 82.3% of patients with expander reconstruction required secondary surgical procedures. In total, 37% of patients who initially had expander reconstruction required a switch from expander to a definitive reconstruction.

For the 54 cancer patients who received PMRT (77.8% implant-based reconstruction versus 22.2% autologous reconstruction), expanders were used in 54.8% of implant based reconstruction. As expected, a high rate of secondary surgical procedures (72.2%) were performed for patients who received PMRT. In this patient subgroup, 30% required removal of the initial expander or implant to achieve a definitive reconstruction.

In total, 177 patients in the whole cohort underwent implant-based IBR. Of the 177 reconstructions, 17 (9.6%) were subsequently converted to autologous reconstruction (16 cancer patients). Seven patients had expanders placed initially, with a high observed rate of PMRT receipt (10/16; 62.5%). Deep inferior epigastric perforator abdominal free flap was performed in 8 patients, with the remaining patients receiving LD flap (+/- implant).

**Table 1. Patient Characteristics, including Potential Risk Factors for Post-operative Complications**

| | Cancer Group (n = 228) | RR Group (n = 71) | *P* |
|---|---|---|---|
| Age, y (mean) | 50.1 (SD 10) | 41.7 (SD 10) | 0.001 |
| Body mass index (mean) | 25.8 (SD 5.9) | 27.8 (SD 6) | 0.33 |
| Smokers | 14% (n = 32) | 11.3% (n = 8) | 0.55 |
| Diabetic | 1.3% (n = 3) | 2.8% (n = 2) | 0.39 |
| Steroids | 0.4% (n = 1) | 0% (n = 0) | 0.58 |
| Mastectomy weight, g (mean) | 524 (SD 297) | 464 (SD 339) | 0.076 |

The RR patients were younger in age. Otherwise, both patient groups were well matched with regard to the potential risk factors.

## DISCUSSION

This study has highlighted interesting similarities and differences in reconstructive practice between the two patient groups. The proportion of patients who underwent implant based reconstruction was similar in both groups. The implant based IBR rate of 63% in RR patients is lower than reported by others in the literature.[6,13] However, this is a single centre study, and variation in surgical practice is anticipated.

Despite the relatively low rate of IBR loss in our cohort, secondary surgery rates were frequent in both groups. Our revisional surgery rate is comparable to a notable study by the Mastectomy Reconstruction Outcome Consortium.[9] This highlights the fact that IBR is not a "one-off"

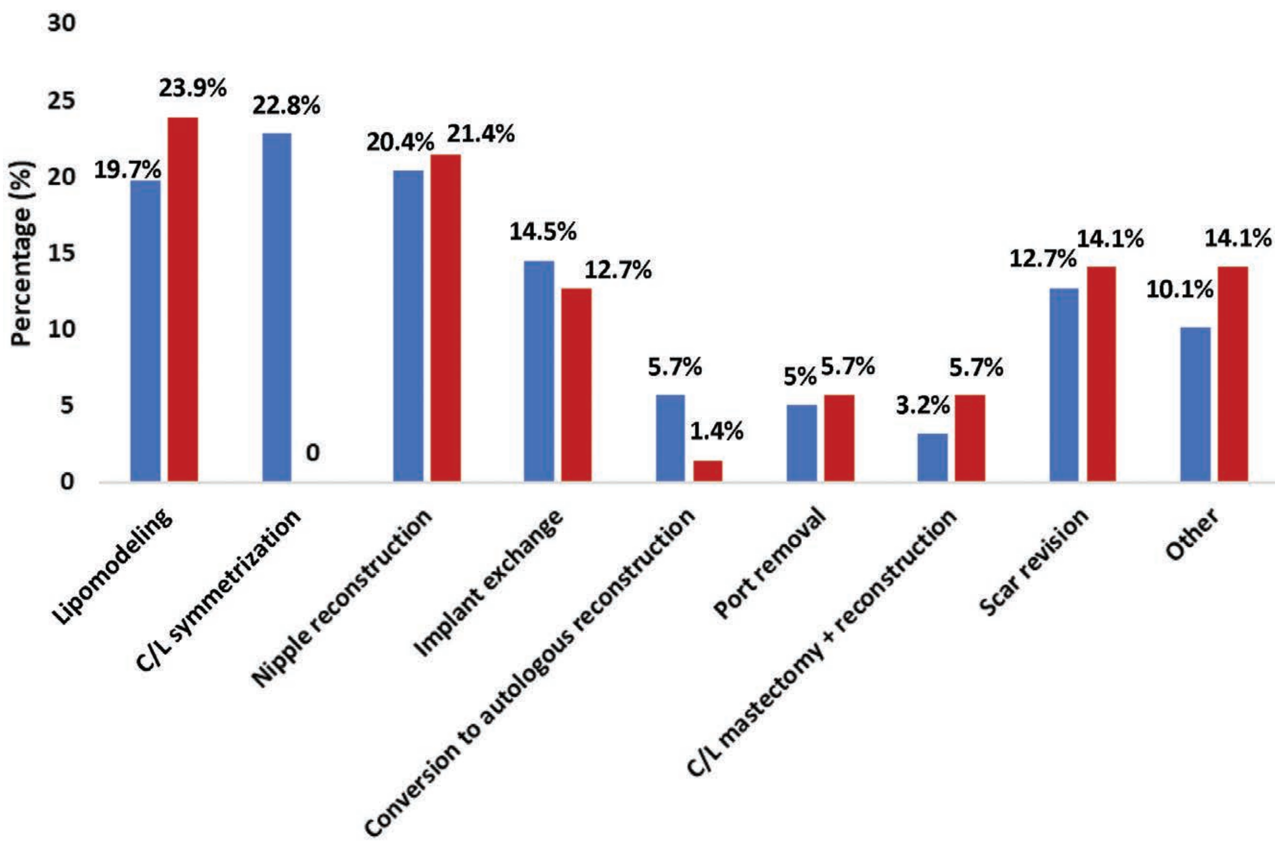


**Fig. 3.** Comparison of the types of secondary surgical procedures (blue: cancer; red: RR). Other procedures included debridement of fat necrosis, excision of seroma cavity, adjustments to the implant pocket, split skin graft, implant removal, and liposuction to reshape autologous flaps. Contralateral (C/L) symmetrization was the commonest procedure performed in cancer patients, as opposed to lipomodeling in RR patients.

procedure and that patients frequently receive secondary surgery to optimize or maintain the quality of reconstruction, improve symmetry, and ultimately improve their quality of life. Therefore, it is important that both patient groups continue to have their needs met in terms of future access to secondary surgical procedures. This is especially evident in cancer patients where 72% of secondary procedures were planned from the initial onset. However, this has to be balanced against resource implications[14] and the potential surgical and anesthetic risks to the patients who opt to undergo further surgery.

Our study finding shows considerable secondary surgery rate of 56.3% in the RR group. In our RR cohort, approximately 1 in 4 patients received unplanned secondary surgery. This is comparable to a study by Zion et al, who reported a higher unplanned secondary surgery rate of 52% for RR patients (with a longer median follow-up of 14 years).[15] Given that the 2 commonest unplanned secondary procedures in our RR cohort was lipomodeling and scar revision, the relatively high rate of unplanned secondary surgery is likely to be driven by the desire to achieve an optimal cosmetic outcome. However, further qualitative studies that measure patient reported outcome measures will be important to explore patient expectation and satisfaction. The current literature suggests that patient satisfaction with reconstruction outcome after RR surgery may be lower than for cancer surgery.[16] A notable study by Orr et al highlights the complexities involved in the patient's decision-making when opting to undergo secondary surgery after IBR.[17] We found that the presence of complication did not significantly influence unplanned surgery rate in the RR cohort.

Our study finding is also similar to that of the Mastectomy Reconstruction Outcome Consortium study, which stated that if complications occur, the risk of future secondary surgery increases.[9] We found this for our cancer patient cohort for whom complication led to an unplanned secondary surgery rate as high as 82.5%. Therefore, strict peri-operative protocols such as these to minimize implant infection[18,19] will also have a potential long-term patient benefit.

In our cohort, nipple-preserving skin-sparing mastectomies were more frequently performed in RR patients. In cancer patients, this could in part be explained if the tumor was close to the NAC. There are also patient choices that are difficult to explore in a retrospective study. Wise-pattern skin-reducing mastectomies were performed equally in both patient groups, which required removal of NAC. It is worth noting that nipple reconstruction was one of the most commonly performed secondary surgical procedure. Therefore, one might consider surgical techniques such as immediate NAC reconstruction[20] to reduce

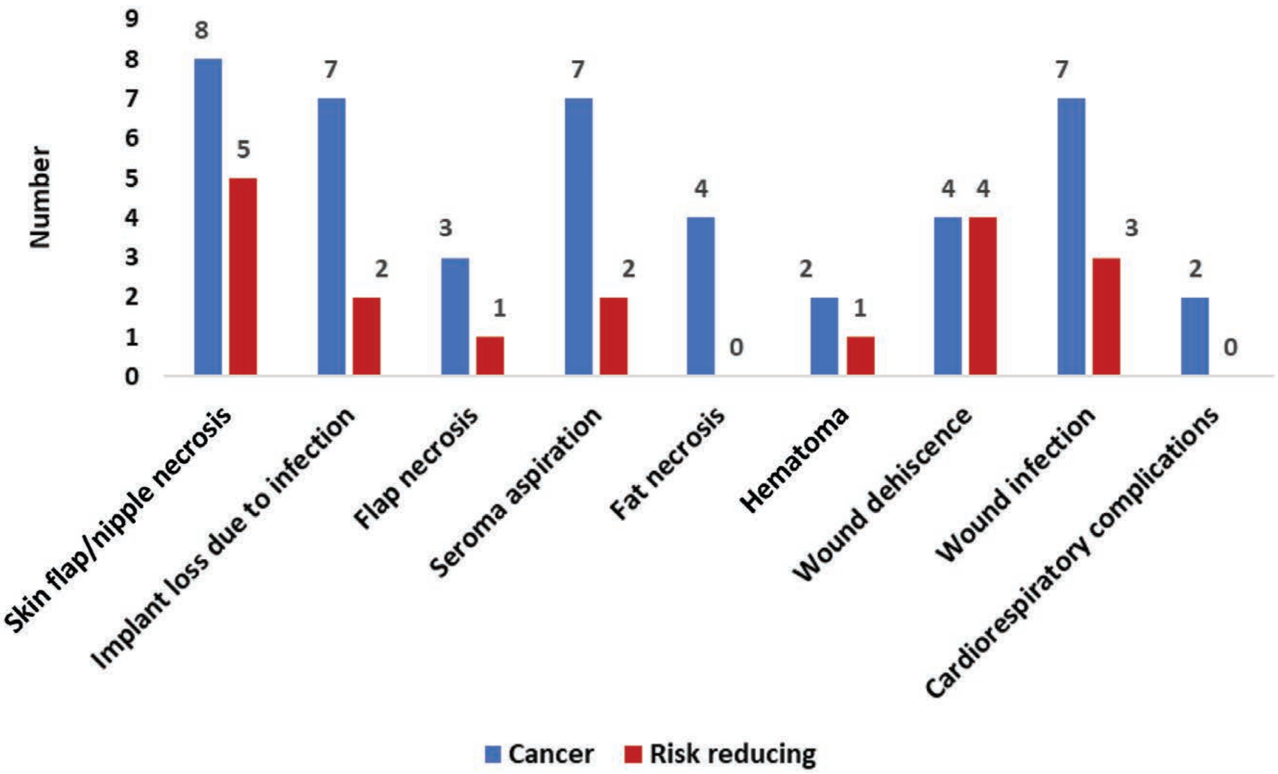


**Fig. 4.** Subgroup analysis denoting the distribution and type of complications observed in cancer and RR patients. Y-axis denotes the number of patients with complications.

secondary surgery rates as well as delay in the completion of reconstructive journey.

Expander usage was more frequently seen in cancer patients. This is likely to be explained by adopting surgical strategies to minimize the risk of wound breakdown and skin flap necrosis when adjuvant treatment such as PMRT is anticipated. This is especially relevant when higher risk wise-pattern mastectomy incisions were required[21] for patients with larger redundant breasts.[22] Although expanders used were deemed "permanent" with external silicone shell and distant port, 37% were exchanged to a definitive reconstruction. This finding is also supported by the results from several studies[9,23] demonstrating high secondary surgery rates after expander usage. Therefore, further surgical technical consideration is required to increase utilization of 1-stage direct-to-implant (DTI) reconstruction while minimizing complications. Advances such as adoption of DTI ADM pre- or sub-pectoral techniques[24] and the use of negative pressing wound therapy[25] may in future aid to reduce expander usage.

As anticipated, a high rate of secondary surgeries were observed for patients who received PMRT (72.2%). Of the patients who underwent implant-based reconstruction in anticipation of PMRT, half were with expanders. These were placed as temporary devices, with plans for secondary surgical procedures, such as conversion to autologous reconstruction. There are now studies emerging that demonstrate lower complication rates in patients who receive PMRT after DTI breast reconstruction when compared with expander reconstruction.[26,27]

The limitation of our study includes a relatively modest follow-up period of almost 5 years. Longer follow-up will facilitate evaluation of whether the type of IBR influences secondary surgery rates. Given its nature, implant-based reconstruction may result in a higher number of secondary surgeries over a patient's lifetime, when compared with autologous reconstruction. The current literature on this subject is conflicting,[28,29] demonstrating the need for a longer term follow-up studies. Our study findings also showed that adjuvant treatment did not influence unplanned secondary surgery rates. Therefore, the patient's decision to undergo secondary surgery is multifactorial and complex, which may be influenced by patient factors,[17] healthcare settings,[30] and surgical practice.[31,32]

## CONCLUSIONS

Our study demonstrates that secondary surgical procedures were frequently performed whether patients were reconstructed after mastectomy for breast cancer or risk reduction. This was despite the low rate of IBR loss.

For cancer patients, most of the secondary surgeries were planned. Complications, not receipt of PMRT or chemotherapy, led to a significantly higher rate of unplanned secondary surgery in cancer patients. Approximately 1 in 4 risk-reducing patients received unplanned secondary surgery, which in contrast was not associated with complications, and may be driven by the desire to achieve an optimal aesthetic outcome. Future qualitative research is

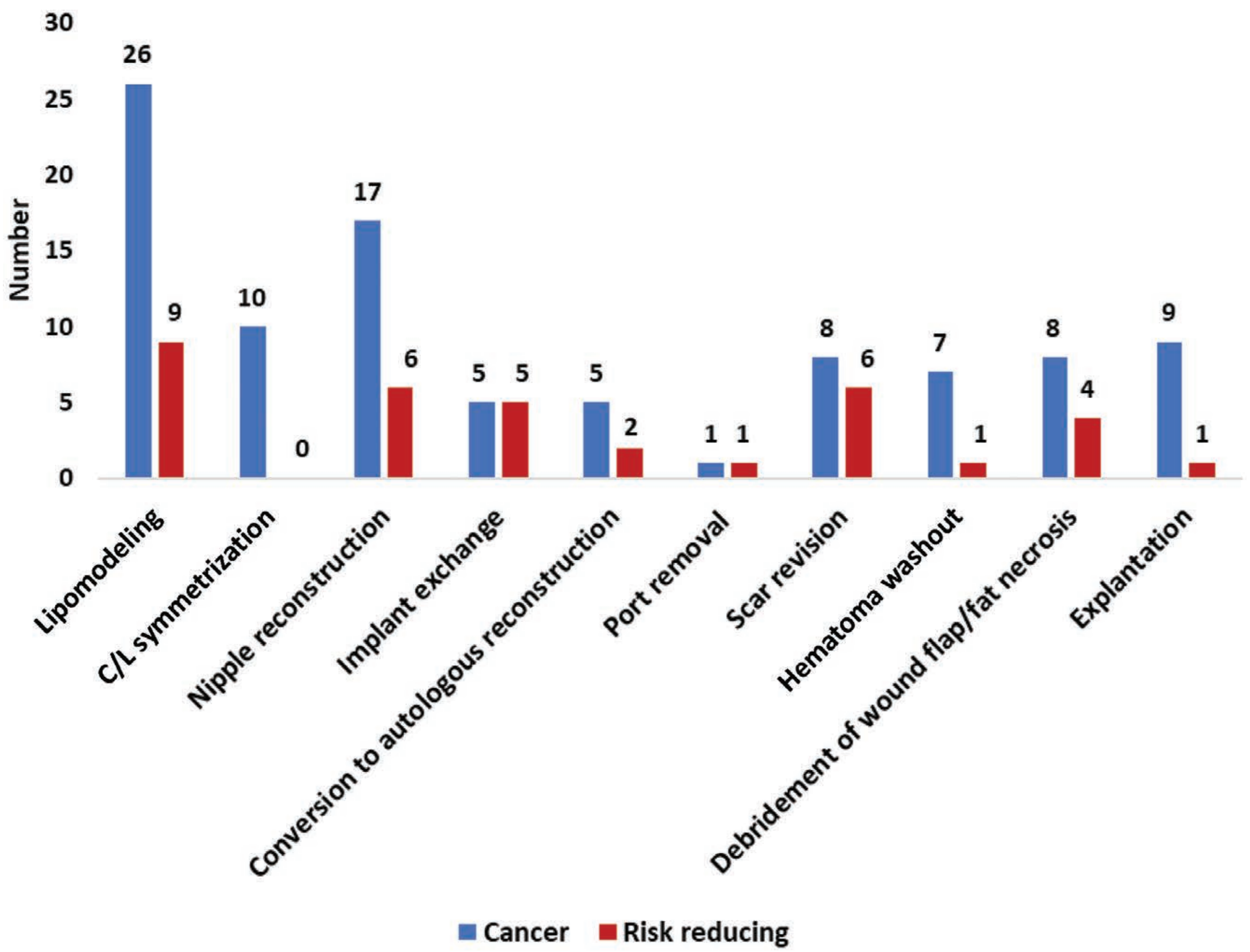


**Fig. 5.** Subgroup analysis of highlighting the type and frequencies of secondary surgery performed in patients who developed complications. Y-axis denotes the number of patients undergoing secondary surgery.

**Table 2. Results of the Univariate Regression Analysis (Spearman's rho)**

| Factors Analyzed | *P* |
|---|---|
| Patient age | 0.080 |
| Smoking status | 0.452 |
| Diabetes | 0.425 |
| Steroid usage | 0.259 |
| Uni or bilateral surgery | 0.340 |
| Skin-sparing or skin-reducing mastectomy | 0.995 |
| Nipple-sparing or nipple-sacrificing mastectomy | 0.102 |
| Type of axillary surgery | 0.312 |
| Adjuvant chemotherapy | 0.637 |
| Neoadjuvant chemotherapy | 0.874 |
| PMRT | 0.288 |

PMRT did not significantly influence unplanned surgery rate; exchange of tissue expander to a definitive reconstruction after PMRT was classified as planned secondary surgery.

required to identify factors that influence the decision to undergo secondary surgery.

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