Comparison of Wound Complications After Immediate, Delayed, and Secondary Breast Reconstruction Procedures

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IMPORTANCE Few data are available concerning surgical site infection (SSI) and noninfectious wound complications (NIWCs) after delayed (DR) and secondary reconstruction (SR) compared with immediate reconstruction (IR) procedures in the breast.

OBJECTIVE To compare the incidence of SSI and NIWCs after implant and autologous IR, DR, and SR breast procedures after mastectomy.

DESIGN, SETTING, AND PARTICIPANTS This retrospective cohort study included women aged 18 to 64 years undergoing mastectomy from January 1, 2004, through December 31, 2011. Data were abstracted from a commercial insurer claims database in 12 states and analyzed from January 1, 2015, through February 7, 2017.

EXPOSURES Reconstruction within 7 days of mastectomy was considered immediate. Reconstruction more than 7 days after mastectomy was considered delayed if the mastectomy did not include IR or secondary if the mastectomy included IR.

MAIN OUTCOMES AND MEASURES International Classification of Diseases, Ninth Revision, Clinical Modification diagnosis codes for SSI and NIWCs.

RESULTS Mastectomy was performed in 17,293 women (mean [SD] age, 50.4 [8.5] years); 61.4% of women had IR or DR. Among patients undergoing implant reconstruction, the incidence of SSI was 8.9% (685 of 7,655 women) for IR, 5.7% (21 of 369) for DR, and 3.2% (167 of 5,150) for SR. Similar results were found for NIWCs. In contrast, the incidence of SSI was similar after autologous IR (9.8% [177 of 1,799]), DR (13.9% [19 of 137]), and SR (11.6% [11 of 95]) procedures. Compared with women without an SSI after implant IR, women with an SSI after implant IR were significantly more likely to have another SSI (47 of 412 [11.4%] vs 131 of 479 [2.7%]) and an NIWC (24 of 412 [5.8%] vs 120 of 479 [2.5%]) after SR. The incidence of SSI (24 of 379 [6.3%] vs 152 of 5,286 [2.9%]) and NIWC (22 of 379 [5.8%] vs 129 of 5,286 [2.4%]) after implant SR was higher in women who had received adjuvant radiotherapy. Wound complications after IR were associated with significantly more breast surgical procedures (mean of 1.92 procedures [range, 0-9] after implant IR and 1.11 [range, 0-6] after autologous IR) compared with women who did not have a complication (mean of 1.37 procedures [range, 0-8] after implant IR and 0.87 [range, 0-6] after autologous IR).

CONCLUSIONS AND RELEVANCE The incidence of SSI and NIWCs was slightly higher for implant IR compared with delayed or secondary implant reconstruction. Women who had an SSI or NIWC after implant IR had a higher risk for subsequent complications after SR and more breast operations. The risk for complications should be carefully balanced with the psychosocial and technical benefits of IR. Select high-risk patients may benefit from consideration of delayed rather than immediate implant reconstruction to decrease breast complications after mastectomy.
Breast reconstruction is increasingly performed after mastectomy in women with breast cancer and for prophylaxis in women at high risk for breast cancer. Steadily increasing use of mastectomy in women with early breast cancer has been reported in the past decade, along with increasing use of bilateral mastectomy, even for unilateral disease. Coinciding with this trend is increased use of immediate breast reconstruction (IR), particularly in women undergoing bilateral mastectomy, more than half of whom undergo reconstruction. Using the Nationwide Inpatient Sample, the proportion of women undergoing mastectomy for cancer or prophylaxis with IR increased by almost 1.5-fold from 28.5% in 2005 to 42% in 2011 (M.A.O., unpublished data; November 2015).

Immediate breast reconstruction is often recommended to women undergoing mastectomy because it is thought to confer psychosocial benefits and result in better cosmesis. The true influence of reconstruction on quality of life is difficult to assess, because women who only undergo mastectomy tend to be older, white, have higher educational attainment, and place less importance on body image than women who undergo breast reconstruction. The perceived benefit of IR does not, however, take into account the potential for serious complications, including delays in initiating chemotherapy and radiotherapy that may affect the potential for cure, survival, quality of life, psychosocial well-being, return to work, and overall cost.

The proportion of women with high-risk characteristics undergoing implant IR has increased 3-fold since the late 1990s, driven primarily by increased use of implant reconstruction. Increased use of IR was found in all high-risk groups by Albornoz et al using the National Cancer Database, including the elderly, women with advanced breast cancer, women with comorbidities, and women who required adjuvant radiotherapy.

Few studies with sufficient sample size in the literature compare wound complication rates, including surgical site infection (SSI) and noninfectious wound complications (NIWCs), to make firm conclusions about the relative incidence of complications after IR vs delayed reconstruction (DR). Given this paucity of data, we compared the incidence of wound complications after implant and/or autologous IR, DR, and secondary breast reconstruction (SR) using insurance claims data from nonelderly (aged 18-64 years) women. The goal of this study was to determine and compare complication rates to facilitate discussion of options with women considering breast reconstruction and the timing of reconstructive surgery after mastectomy (ie, IR vs DR).

**Methods**

**Data**

We conducted a retrospective cohort study using data from 12 Anthem-affiliated plans in the HealthCore Integrated Research Database, including individuals from 12 Anthem-affiliated plans (California, Connecticut, Georgia, Indiana, Kentucky, Maine, Missouri [excluding 30 counties in the Kansas City area], Nevada, New Hampshire, New York, Ohio, and Virginia [excluding the northern suburbs of Washington, DC]). Data include all fully adjudicated claims submitted from clinicians, facilities, and outpatient pharmacies linked to health plan enrollment information. Fully insured women with enrollment in a fee-for-service plan and complete medical coverage were eligible for cohort inclusion. We excluded women with codes for end-stage renal disease, organ transplant, or human immunodeficiency virus owing to unique risk factors for complications. Medical claims were restricted to paid claims. This study was approved by the Washington University Human Research Protection Office, which did not require informed consent for this retrospective review of claims data.

**Patient Population**

We identified mastectomy operations among women aged 18 to 64 years from January 1, 2004, through December 31, 2011, using *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) and/or Current Procedural Terminology, 4th edition (CPT-4) procedure codes from inpatient and outpatient facility and clinician claims, as previously described.* We limited primary analyses to the first mastectomy per patient and the first subsequent reconstruction procedure within 365 days of mastectomy. We required at least 90 days of insurance coverage after the mastectomy and after the first DR or SR to identify SSI and NIWCs. Patient characteristics, including demographic features, comorbidities, and cancer-related and operative factors, were defined as previously described.

**Procedure Dates and Definitions**

Mastectomy and reconstruction dates within 7 days were collapsed into single-surgery dates because of potential date inaccuracy. An implant or autologous breast reconstruction code within 7 days of the index mastectomy was considered IR. Breast reconstruction coded more than 7 days after the mastectomy date was considered to be a subsequent reconstruction, which we defined as delayed if the index mastectomy did not involve IR and secondary if the index mastectomy included IR.
**Classification of Procedures**

We classified mastectomy and IR as described previously. Implant IR included tissue expander and permanent implant insertion; autologous IR included latissimus dorsi, transverse rectus abdominis myocutaneous, deep inferior epigastric artery perforator, superficial inferior epigastric artery, and gluteal artery perforator flaps. Delayed reconstruction included implant insertion and/or autologous reconstruction; SR included implant insertion, exchange of tissue expander or permanent prosthesis (CPT-4 code 11970 or codes for implant removal plus insertion), and/or autologous reconstruction. Implant DR procedures were excluded if another implant reconstruction code(s) was used, suggesting that the procedures were more likely to be second stage (CPT-4 codes 11970, 11971, 19328, 19370, 19371, or 19380; ICD-9-CM procedure codes 85.93, 85.94, or 85.96). Secondary reconstruction included second-stage or revision ipsilateral reconstruction and symmetry procedures on the contralateral breast. In addition to the implant and autologous procedures captured as part of IR, DR, or SR, other reconstruction procedures were captured within 2 years after the index mastectomy, including implant removal without insertion, revision of reconstruction, mastopexy, capsulectomy, nipple reconstruction, and reduction mammoplasty.

**Identification and Timing of SSIs and NIWCs**

We identified SSIs using a claims-based adaptation of the Centers for Disease Control and Prevention National Healthcare Safety Network definition of SSI. We identified NIWCs (ie, tissue necrosis, dehiscence, hematoma, and fat necrosis) using ICD-9-CM diagnosis codes, as described previously. The time frame for identifying wound complications was limited to 2 to 90 days after each immediate, delayed, and secondary reconstructive operation (1-90 days for hematoma; hematomas can occur soon after the procedure) because we only required health insurance coverage through 90 days after each procedure. Complications were further categorized by severity. We defined serious complications as those diagnosed during an inpatient admission or within 14 days before or after surgical wound care (incision/drainage codes except ICD-9-CM procedure codes 85.91, 86.01, and 86.28) requiring reoperation (identified by UB-04 medical revenue code[s] for operating room services) or implant removal or exchange (CPT-4 code 11970 or codes for implant removal plus insertion). In the analysis of complications after secondary reconstruction, 198 women with implant IR were excluded because they had an SSI coded more than 90 days after the index mastectomy, of whom 105 underwent SR. Similarly, 136 women with implant IR were excluded because they had an NIWC coded more than 90 days after the index mastectomy, of whom 79 underwent SR.

**Identification of Chemotherapy and Radiotherapy**

Adjuvant treatment was defined as having 2 or more distinct dates coded for radiotherapy or chemotherapy, as defined previously except for ICD-9-CM diagnosis codes for chemotherapy and radiotherapy and CPT-4 code 96402 for chemotherapy. We examined the association of radiotherapy with complications after DR and SR, including only radiotherapy after mastectomy and before DR or SR. To examine the association of IR complications within 90 days with initiation of adjuvant chemotherapy and radiotherapy, we determined the time to first chemotherapy and/or radiotherapy treatment within 365 days of mastectomy, excluding women who had treatment initiation before a wound complication.

**Statistical Analysis**

Data were analyzed from January 1, 2015, through February 7, 2017. We compared the incidence of wound complications within 90 days after IR, DR, or SR using a chi-square test or logistic regression for unpaired comparisons. The McNemar test was used for paired comparisons of complications after implant IR vs implant SR within a woman. A Kruskal-Wallis test was used to compare continuous variables. All data management and statistical analyses were performed using SAS software (version 9.3; SAS Institute Inc).

**Results**

A total of 17,293 women (mean [SD] age, 50.4 [8.5] years) with mastectomy met study eligibility criteria (Table 1). Mastectomy procedures included IR in 10,047 women (58.1%), of which 7655 (76.2%) involved an implant only; 1799 (17.9%), autologous reconstruction; and 593 (5.9%), autologous plus implant reconstruction. A total of 6425 women had at least 1 subsequent breast reconstruction procedure within 1 year after mastectomy; the breakdown of DR vs SR and type of reconstructive procedure is shown in Figure 1. Most implant IR and implant DR procedures involved tissue expanders (7102 [92.8%] and 349 [94.6%, respectively), whereas most implant SR procedures involved a permanent implant (5207 [91.9%]).

Women who had DR (vs IR) were more likely to live in a rural (vs urban) location (69 [18.8%] vs 667 [9.7%]; P < .001), have tobacco use disorder (62 [16.8%] vs 831 [12.1%]; P = .007); use oral corticosteroids (54 [14.7%] vs 695 [10.1%]; P = .01); have anemia (29 [7.9%] vs 379 [5.5%]; P = .05); have a higher cancer stage, defined as regional or metastatic cancer (135 [23.5%] vs 1734 [17.3%]; P < .001); and were less likely to have had previous breast cancer (45 [12.2%] vs 1170 [17.0%]; P = .02). Women with DR were also more likely to have undergone modified radical mastectomy (163 [44.3%] vs 2227 [32.4%]; P < .001) and unilateral mastectomy (240 [65.2%] vs 3118 [45.3%]; P < .001).

**Overall Wound Complication Incidence After Reconstruction**

The incidence of SSI and NIWCs within 90 days after IR, DR, and SR are shown in Table 1. Overall, 865 SSIs (74.9%) and 734 NIWCs (59.0%) were categorized as serious complications. The incidence of SSI and NIWCs were significantly higher after implant IR (373 of 5150 [7.2%] and 420 of 5150 [8.2%], respectively) compared with implant SR (167 of 5150 [3.2%] and 134 of 5150 [2.6%]; P < .001 for both in matched comparisons within a woman) (Table 1). The 90-day SSI incidence was significantly higher after implant IR (685 of 7655 [8.9%]) compared with implant DR (21 of 369 [5.7%]; P = .04) (Table 1). The
SSI incidence was also significantly higher after implant IR compared with implant SR after autologous tissue flap plus implant IR (6 of 340 [1.8%]; P < .001) and with implant SR after autologous IR (3 of 175 [1.7%]; P = .003). Similarly, the 90-day NIWC rates were significantly higher after implant IR (717 of 7655 [9.4%]) compared with implant DR (15 of 369 [4.1%]) and implant SR after autologous tissue flap plus implant IR (9 of 340 [2.7%]; P = .001) and with implant SR after autologous tissue flap IR (8 of 175 [4.6%]; P = .03). In contrast, the 90-day wound complication rates were similar in women who underwent autologous tissue flap reconstruction regardless of the timing of reconstruction (Table 1). In women undergoing IR, we found no difference in the incidence of SSI (629 of 7102 [8.9%] vs 56 of 553 [10.1%; P = .31] or NIWC (664 of 7102 [9.3%] vs 53 of 553 [9.6%]; P = .86) based on the use of tissue expanders vs permanent implants.

Failed implant reconstruction, defined as implant removal or exchange within 60 days of insertion, occurred in 532 women (7.0%) after IR and 30 women (8.1%) after DR (P = .39). Among women with SSI, implant failure occurred in 300 IR (43.8%) and 12 DR procedures (57.1%; P = .23).

**Influence of Wound Complications After IR**

The association of SSI after implant IR with wound complications after SR is shown in Figure 2A. The incidence of SSI after SR (implant or autologous) in women who had an SSI after implant IR was significantly higher than in women who did not have an SSI within 365 days after implant IR (47 of 412 [11.4%] vs 131 of 4791 [2.7%]; P < .001). An analogous result was obtained for NIWCs, with significantly higher incidence of NIWCs in women who had an SSI after implant IR compared with women without an SSI after implant IR (24 of 412 [5.8%])

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**Figure 1. Diagram of Study Population, Including Index Mastectomy and Immediate and Subsequent Reconstruction After Mastectomy**

<table>
<thead>
<tr>
<th>Immediate reconstruction</th>
<th>Subsequent reconstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>7655 Implant IR^c</td>
<td>5150 Implant SR</td>
</tr>
<tr>
<td>1799 Autologous IR^d</td>
<td>175 Implant SR</td>
</tr>
<tr>
<td>593 Flap + implant IR^e</td>
<td>340 Implant SR</td>
</tr>
<tr>
<td>17293 Patients undergoing mastectomy^a</td>
<td>6672 No reconstruction</td>
</tr>
</tbody>
</table>

^a We required all women included in the study population to have at least 90 days of insurance coverage after mastectomy. The women with subsequent breast reconstruction procedure(s) were more likely to have at least 1 year of health insurance coverage after mastectomy than those without a subsequent reconstruction procedure (5763 [89.7%] vs 8194 [75.4%]; P < .001). Among women with less than 1 year of coverage after mastectomy, those with a subsequent procedure had a greater median number of days of health insurance coverage (295 vs 227 days; P < .001).

^b Immediate reconstruction (IR) occurred within 7 days of mastectomy.

^c Includes tissue expander or permanent implant.

^d Includes use of an autologous tissue flap (abdominal, buttock, and back tissue transferred on its vascular pedicle or by free tissue transfer microsurgical Anastomosis techniques).

^e Includes use of an implant and autologous tissue flap, as defined above.

^f Includes a woman’s first subsequent reconstruction 8 to 365 days after the index mastectomy. The first subsequent implant reconstruction (secondary reconstruction [SR] or delayed reconstruction [DR]) was performed a median of 156 days after mastectomy (interquartile range [IQR], 112-210 days); the first subsequent autologous reconstruction (with or without implant), a median of 232 days (IQR, 157-294 days) after mastectomy (P < .001). Implant DR was performed at a later date after mastectomy than was implant SR (181 days [IQR, 113-252 days] vs 155 days [IQR, 112-207 days]; P < .001), and autologous DR was performed at a later date than was autologous SR (250 days [IQR, 189-299 days] vs 209 days [IQR, 133-279 days]; P = .007).

^g Performed in patients without IR.

^h Indicates no implant or flap reconstruction within 365 days of mastectomy.

Implant procedures consistent with contralateral procedures were included in this group (eg, implant insertion in a woman with unilateral mastectomy without immediate reconstruction but with other code(s) consistent with secondary implant procedures [eg, capsulectomy]). Because we only required 90 days of health insurance enrollment after mastectomy, some women may have had DR at 91 to 365 days that we could not identify owing to cessation of insurance coverage.
vs 120 of 4791 [2.5%]; \(P < .001\)). When the analysis was restricted to women who had only implant SR (excluding women with autologous SR after implant IR), the SSI rate after implant SR remained significantly higher in women who had an SSI after implant IR compared with women without an SSI after implant IR (42 of 373 [11.3%] vs 117 of 4673 [2.5%]; \(P < .001\)). Similar to the results depicted in Figure 2A, the rates of NIWC and SSI after SR were significantly higher in women with an NIWC after implant IR (35 of 455 [7.7%] and 42 of 455 [9.2%], respectively; \(P < .001\)) (Figure 2B).

Compared with women without a wound complication after IR, women with IR-associated wound complications underwent significantly more breast procedures within 2 years after the index operation (Table 2). The difference in number of procedures after implant IR was greater in women with SSI (mean, 2.08; range, 0-9) and NIWCs (mean, 1.88; range, 0-9) vs women without a wound complication (1.37; range, 0-8) than in women after autologous IR with SSI (mean, 1.14; range, 0-6) and NIWCs (mean, 1.12; range, 0-6) vs women without a wound complication (mean of 0.87; range, 0-6). Women who had a wound complication after IR started chemotherapy 2 weeks later than women who did not have an IR wound complication (median start of chemotherapy, 53 vs 39 days after mastectomy; \(P < .001\)). Similarly, women who had a wound complication after IR had a median 3-week delay in initiation of radiotherapy compared with women who did not have a wound complication after IR (median start of radiotherapy, 162 vs 142 days after mastectomy; \(P < .001\)).

### Association of Adjuvant Radiotherapy With Incidence of Wound Complications

Adjuvant radiotherapy was administered after mastectomy to 34 of 369 women before implant DR (9.2%) and 379 of 5665 women before implant SR (6.7%) (Table 3). Prior receipt of adjuvant radiotherapy was associated with approximately 2-fold higher incidence of wound complications after implant SR but was not associated with higher complication rates in women who underwent implant DR after adjuvant radiotherapy (Table 3). Among women who had subsequent autologous tissue reconstruction, 85 of 205 (41.5%) with autologous DR and 51 of 186 (27.4%) with autologous SR received adjuvant radiotherapy before the reconstruction. The incidence of any wound complication was not significantly different when comparing implant DR, autologous DR, or autologous SR according to receipt of adjuvant radiotherapy, although the number of women with complications in individual comparisons was very small (Table 3).

### Discussion

To our knowledge, this study is the largest to date comparing rates of SSI and NIWCs after immediate, delayed, and secondary breast reconstruction. We found that the incidence of wound complications was higher after implant IR than after implant DR or SR. In contrast, no difference was found in the incidence of complications after autologous IR com-
pared with autologous DR or SR, although the number of procedures was smaller. Our finding of lower rates of wound complications after DR compared with IR is important because the women who had DR were more likely to have characteristics associated with a higher risk for SSI than were women who underwent IR (eg, tobacco use disorder, rural residence). Thus, these women likely would have had even higher wound complication rates if they underwent immediate rather than delayed reconstruction. Wound complications after implant IR were associated with high rates of implant failure, and women who had wound complications after implant IR were also more likely have additional wound complications after secondary reconstructive procedures. Women who had a wound complication after IR underwent more subsequent breast procedures and had delayed adjuvant treatment initiation compared with women who did not have a wound complication after IR.

Consensus is lacking in the literature regarding differences in complication rates after IR vs DR for autologous tissue flap and implant reconstructions. Several small studies\cite{15-18} have reported similar wound complication rates after autologous IR vs DR, whereas others\cite{19-20} have found higher complication rates after autologous IR. Sullivan and colleagues\cite{15} reported a higher incidence of overall complications after implant IR compared with DR procedures, whereas 2 other groups\cite{21,22} reported no difference, although these studies included only a small number of implant DR procedures. Consistent with our finding of increased incidence of wound complications after implant IR vs implant SR, Lovecchio et al\cite{23} and Cordeiro and McCarthy\cite{24} reported significantly higher complication rates after implant IR compared with SR exchange procedures. In contrast to studies that did not find a difference in complication rates, our study was larger and we compared wound complication rates after implant IR vs SR within a woman using matched-pairs analysis to account for lack of independence of events.

Several investigators\cite{24-26} have used the National Surgical Quality Improvement Program database to analyze 30-day complication rates after IR compared with DR. Gart and colleagues\cite{24} reported a decreased risk for SSI and total complications associated with immediate compared with delayed autologous reconstruction, although these findings varied by tissue flap type. Chung et al\cite{25} found no difference in SSI rates between IR and DR microvascular autologous tissue flap procedures. More recently, Sanati-Mehrizy et al\cite{26} found an increased risk for 30-day complications after autologous DR and implant DR using tissue expanders compared with IR. In contrast to the National Surgical Quality Improvement Program studies, we compared SSI and NIWC rates after IR, DR, and SR procedures and identified complications within 90 days of operation rather than 30 days, based on a previous finding\cite{27} that only 50% of SSIs were identified within 30 days of mastectomy with implant IR but almost 90% were identified within 90 days.

One possible explanation for increased complication rates after implant IR is the substantial dead space and hypovascu-
Wound Complications After Breast Reconstruction Procedures

Original Investigation  Research

Table 2. Subsequent Breast Reconstruction and Revision Procedures Within 2 Years of Immediate Reconstruction According to 90-Day Complications After Immediate Implant or Autologous Reconstruction

<table>
<thead>
<tr>
<th>Type of IR, Complication</th>
<th>No. of Complications ±90 d After Mastectomyb</th>
<th>No. of Subsequent Reconstruction or Revision Procedures, Mean (Range)c</th>
<th>P Valued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implant (n = 7655)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>6475</td>
<td>1.37 (0-8)</td>
<td>Reference</td>
</tr>
<tr>
<td>SSI</td>
<td>685</td>
<td>2.08 (0-9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>NIWC</td>
<td>717</td>
<td>1.88 (0-9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>SSI or NIWC</td>
<td>1180</td>
<td>1.92 (0-9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Autologous flap only (n = 1799)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1457</td>
<td>0.87 (0-6)</td>
<td>Reference</td>
</tr>
<tr>
<td>SSI</td>
<td>177</td>
<td>1.14 (0-6)</td>
<td>.002</td>
</tr>
<tr>
<td>NIWC</td>
<td>250</td>
<td>1.12 (0-6)</td>
<td>.002</td>
</tr>
<tr>
<td>SSI or NIWC</td>
<td>342</td>
<td>1.11 (0-6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Autologous flap plus implant (n = 593)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>495</td>
<td>1.30 (0-7)</td>
<td>Reference</td>
</tr>
<tr>
<td>SSI</td>
<td>52</td>
<td>1.58 (0-5)</td>
<td>.34</td>
</tr>
<tr>
<td>NIWC</td>
<td>63</td>
<td>1.41 (0-4)</td>
<td>.64</td>
</tr>
<tr>
<td>SSI or NIWC</td>
<td>98</td>
<td>1.51 (0-5)</td>
<td>.22</td>
</tr>
</tbody>
</table>

Abbreviations: IR, immediate reconstruction; NIWC, noninfectious wound complication; SSI, surgical site infection.

* Subsequent reconstruction or revision procedures included the first secondary implant or autologous procedure; implant removal without insertion, revision of reconstruction, mastectomy, capsulectomy, nipple reconstruction, reduction mammoplasty, and any additional subsequent autologous or implant procedures (ie, autologous and implant insertion codes in addition to the following: Current Procedural Terminology, 4th edition codes 11970, 11971, 11931, 19328, 1930, 19370, 19371, and 19380; International Classification of Diseases, Ninth Revision, Clinical Modification procedure codes 85.31, 85.32, 85.6, 85.87, 85.89, 85.93, 85.94, and 85.96).

Claims data were designed for administrative purposes and have limitations, including misclassification of diagnoses and likely undercoding of SSIs and NIWCs, especially minor complications treated without additional procedures during the 90-day global surgical reimbursement period. A previous study reported the positive predictive values for identification of SSIs and NIWCs in this same population based on medical record review. Although the positive predictive value for SSI (57.5%) was lower than for a composite NIWC group (dehiscence or fat or tissue necrosis, 86.8%), most of the patients coded in error for SSI had a documented wound complication (most often cellulitis or an NIWC). Some of the procedures that we identified as SR may have been symmetry procedures on the contratol-
Conclusions

We found an increased incidence of infectious and noninfectious wound complications after immediate compared with delayed implant reconstruction, despite the higher risk profile of the population undergoing DR. Confirmation of these results in a prospective multicenter study that tracks individual outcomes in all settings will be important to verify the increased risk for wound complications after IR. Our finding of poorer outcomes associated with IR complications, including increased wound complication rates after the next reconstruction procedure, more subsequent breast procedures, and delay of the start of adjuvant treatment, underscores the need to communicate individualized complication risk to women considering IR. Consideration of the timing of implant reconstruction in relation to radiotherapy is also important. Our results suggest that some high-risk patients may benefit from delayed rather than immediate implant reconstruction or from the use of autologous reconstruction to decrease their risk for serious wound complications. Given trends of patients with increasingly medically complex problems undergoing breast reconstruction, tailoring of preventive measures to patients’ unique risk factors and/or careful consideration of the best timing of reconstruction may be needed to prevent complications after immediate and subsequent breast reconstruction procedures.

Table 3. Incidence of 90-Day Complications After Delayed and Secondary Breast Reconstruction According to Receipt of Adjuvant Radiotherapy

<table>
<thead>
<tr>
<th>Reconstruction Type</th>
<th>No. of Patients</th>
<th>Complication</th>
<th>SSI</th>
<th>NIWC</th>
<th>SSI or NIWC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>No. (%)</td>
<td>P Value&lt;sup&gt;b&lt;/sup&gt;</td>
<td>No. (%)</td>
</tr>
<tr>
<td>Implant DR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>34</td>
<td>4 (11.8)</td>
<td>.12&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>No radiotherapy</td>
<td>335</td>
<td>17 (5.1)</td>
<td></td>
<td></td>
<td>13 (3.9)</td>
</tr>
<tr>
<td>Autologous tissue flap ± implant DR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>85</td>
<td>5 (5.9)</td>
<td>.04</td>
<td></td>
<td>9 (10.6)</td>
</tr>
<tr>
<td>No radiotherapy</td>
<td>120</td>
<td>18 (15)</td>
<td></td>
<td></td>
<td>18 (15)</td>
</tr>
<tr>
<td>Implant SR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>379</td>
<td>24 (6.3)</td>
<td>&lt;.001</td>
<td></td>
<td>22 (5.8)</td>
</tr>
<tr>
<td>No radiotherapy</td>
<td>5286</td>
<td>152 (2.9)</td>
<td></td>
<td></td>
<td>129 (2.4)</td>
</tr>
<tr>
<td>Autologous tissue flap ± implant SR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiotherapy</td>
<td>51</td>
<td>5 (9.8)</td>
<td>.69</td>
<td></td>
<td>1 (2)</td>
</tr>
<tr>
<td>No radiotherapy</td>
<td>135</td>
<td>16 (11.9)</td>
<td></td>
<td></td>
<td>20 (14.8)</td>
</tr>
</tbody>
</table>

Abbreviations: DR, delayed reconstruction; NIWC, noninfectious wound complication; SR, secondary reconstruction; SSI, surgical site infection.

<sup>a</sup> Adjuvant radiotherapy was administered after mastectomy and before DR or SR.

<sup>b</sup> Calculated using the χ² test, unless otherwise indicated.

<sup>c</sup> Calculated using the Fisher exact test.
Wound Complications After Breast Reconstruction Procedures

Original Investigation Research

REFERENCES


