An Analysis of Complication Risk Factors in 641 Nipple Reconstructions

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Abstract: Nipple-areola reconstruction represents the completion of the breast restorative process following mastectomy, making it an important part of the multidisciplinary approach to breast cancer and its treatment. Cited benefits of undergoing nipple reconstruction include improved patient satisfaction with the overall reconstructed breast and positive psychological implications (1,2).

Complications associated with breast mound reconstruction have been thoroughly reviewed in the literature. Although there is a benefit in the management of the breast malignancy, chest-wall irradiation is detrimental to both autologous and implant-based breast reconstructions. In addition to radiation, tobacco use, diabetes, and obesity have been shown to be associated with increased complication rates in patients undergoing breast mound reconstruction (3–5). Evaluation of such complication risk factors in the setting of nipple reconstruction, however, has not been widely reported.

The aim of this study was to determine if patient characteristics such as breast mound reconstruction technique, nipple reconstruction local flap technique, tobacco use, obesity, and medical comorbidities were associated with an increased incidence of complications following nipple reconstruction by reviewing cases performed at our institution.

METHODS

Data Collection

An Institutional Review Board-approved, retrospective review of patients who underwent nipple
reconstruction at Wake Forest University over a 15-year period was conducted. Candidate patients for inclusion in the study were identified using Current Procedural Terminology codes. Patient records were reviewed and demographic characteristics including age, body mass index, smoking status, and history of diabetes and hypertension were collected. Cancer treatment history was assessed to determine if the patient received chemotherapy and/or radiotherapy. Finally, surgical details were reviewed. Breast mound reconstruction was classified as autologous, autologous with implant, tissue expander-to-implant or immediate implant. The type of local flap used for nipple reconstruction was also recorded. Postoperative clinic notes for all patients were evaluated to determine if nipple reconstruction complications, including nipple necrosis, tip loss, wound infection, wound breakdown, and inadequate or excessive projection had occurred. Projection complications were classified as those for which patients underwent an additional procedure to reduce or augment projection. This was typically driven by patient satisfaction and/or gross asymmetry.

Statistical Analysis

Descriptive statistics, including means and standard deviations for continuous data and frequencies, as well as proportions for categorical measures, were generated. Generalized estimating equations were utilized to fit a logistic model to assess differences in the rates of nipple complications and nipple projection problems. Single variable models were created for each variable of interest, and a multivariable model was fit, initially using the single variable models with \( p < 0.25 \). These models were reduced in a stepwise fashion by removing one nonsignificant variable at a time and refitting the model until all remaining variables had p-values < 0.05.

RESULTS

Four hundred and seventy-two patients who underwent a total of 641 nipple reconstructions at our institution were identified and included in the study. Patients age ranged from 17 to 80 years at the time of nipple reconstruction with an average age of 49.7 years. Twenty-nine percent of patients were active tobacco users, 38.6% had hypertension, and 11.7% had diabetes (Table 1). The average length of postoperative follow-up was 56.5 months.

The majority of patients underwent implant-based reconstruction (71.5%). Star and skate flaps were the most frequently used local flaps for nipple reconstruction, 45.4% and 42.9%, respectively. Radiation prior to nipple reconstruction was required in 146 breasts (22.6%). Rates of adjuvant therapy and reconstructive techniques are shown in Table 2.

A review of postoperative visit records revealed a complication rate of 10.3% (Table 3). The most frequently identified complications included projection problems (7.6%) with 3.6% of patients experiencing excessive projection and 4.1% experiencing loss of projection. Other documented complications included nipple necrosis, wound infection, and wound dehiscence. Nine patients (1.4%) ultimately went on to have their implants removed, but only four cases (0.6%) were directly attributed to complications related to nipple reconstruction.

Single variable models showed an increased rate of complications seen in patients with a diagnosis of hypertension and diabetes, but this was not statistically significant with a p-value of 0.055 and 0.058, respectively. A significantly higher rate of both nipple projection problems and other complications were, however, seen when comparing skate and star flap reconstruction (\( p = 0.046 \) and 0.001, respectively). Implant-based reconstruction and radiation were also

### Table 1. Patient Demographics

| Characteristic         | Number/Percent |
|------------------------|----------------|
| Age                    | 49.7           |
| Body mass index        | 27.6           |
| Hypertension           | 38.6%          |
| Diabetes mellitus      | 11.7%          |
| Current tobacco use    | 29.0%          |

### Table 2. Treatment Characteristics

| Characteristic                  | Percent (n) |
|---------------------------------|-------------|
| Adjuvant therapies              |             |
| Chemotherapy                    | 25.3 (162)  |
| Radiation                       | 30.9 (198)  |
| Reconstruction method           |             |
| Autologous                      | 17.6 (113)  |
| Implant-based                   | 71.5 (458)  |
| Autologous + Implant            | 10.9 (70)   |
| Nipple technique                |             |
| Skate flap                      | 45.4 (291)  |
| Star flap                       | 42.9 (275)  |
| Arrow/cap flap                  | 5.9 (38)    |
| CV flap                         | 4.5 (29)    |
| Other                           | 1.2 (8)     |
associated with significantly more nipple projection problems (p = 0.009 and 0.05, respectively). When autologous breast mound reconstruction was compared to implant-based reconstruction, patients with a BMI less than 30 were significantly less likely to have nipple projection problems with autologous reconstruction. A summary of statistical analysis performed is in Tables 4 and 5.

**DISCUSSION**

Nipple reconstruction is a well-tolerated procedure, often performed in the clinic setting with only local anesthetic. While loss of projection is frequently seen, with reported postoperative nipple height loss of 26.1–75% compared to intra-operative measurements (6–8), other complications are infrequent and typically minor. Reported rates of other complications including tip necrosis, wound dehiscence, and local infection range from 4% to 12.1% with revision rates ranging from 2% to 8.6% (7,9).

Although complications following nipple reconstruction are usually managed with noninvasive treatments—local wound care and antibiotics, surgical intervention is sometimes required. Revisions for inadequate projection and minor debridement can typically be performed under local anesthesia in the clinic. Less frequently, however, severe wound infection or tissue loss can result in implant infection, necessitating operative intervention. In a review of 189 nipple reconstructions, Momeni, et al. reported that nine patients (4.8%) went on to require implant exchange or removal as a result of complications attributed to nipple reconstruction (10).

Four nipple reconstructions (0.6%) in three patients in our review resulted in complications which ultimately led to implant removal. One patient who underwent bilateral skate flap nipple reconstruction developed nipple necrosis and subsequent infection requiring bilateral implant removal. She eventually underwent bilateral latissimus dorsi flaps with tissue expanders, later replaced with implants with repeat nipple reconstruction. A second patient developed a small tract at the suture line of her star flap nipple reconstruction, which later opened further and resulted in implant exposure with subsequent implant removal. The third patient was noted to have cellulitis about 1 month following nipple reconstruction, which failed to improve with antibiotics and was associated with a periprosthetic fluid collection diagnosed by ultrasonography. The implant was, therefore, removed. The patient later underwent reconstruction with a latissimus dorsi flap with immediate implant placement and subsequent repeat nipple reconstruction. Five other patients were documented to have had their implants removed at some point following nipple reconstruction due to implant infection (n = 4) or capsular contracture (n = 1). Based on the clinical course and timing, however, they were not felt to be directly attributable to the nipple reconstruction.
Not all patients elect to have nipples reconstructed with reported rates of nipple reconstruction complication among patients undergoing breast mound reconstruction range from 50% to 88% (1,11,12). As an elective procedure with morbidity associated with potential complications—additional surgery following implant loss and the impact on quality of life for those requiring prolonged wound care with nipple necrosis or dehiscence, it would beneficial to know which patients might be more likely to have complications.

Although the literature is limited regarding possible risk factors associated with nipple reconstruction complications, previous studies suggest radiation may have a negative impact. A “matched-pair” study showed that seven of eight complications seen in 17 patients undergoing bilateral nipple reconstruction occurred on the irradiated side (p = 0.03) (13). Another retrospective review of 28 patients with a history of radiation identified a nipple reconstruction complication rate of 25%, which the authors deemed higher than the 10–15% reported in the literature in patients without a history of radiation (14).

Among our 146 nipple reconstructions (22.8%) performed on irradiated breasts, 25 (17.1%) experienced postoperative complications. Radiation was associated with a statistically significant higher rate of projection-related complications (p = 0.05). Given the established negative effects of radiation on breast skin, it seems that these skin changes could account for an increased rate of complications (15). Other factors, including hypertension and diabetes, also associated with wound healing delays, may also impact wound complications in nipple reconstruction as seen with the trend toward significance of complication rates in this study.

Interestingly, smoking was not identified as an independent variable associated with higher complication rates. Based on previous reports showing increased complications with local flaps in facial reconstruction, it might be expected that smoking would have a similar detrimental effect on local flaps used for nipple reconstruction (16). Compared to local flaps on the face which are designed to fill a specific defect which may require some degree of tension to close, local flaps in nipple reconstruction are loosely arranged and the flap limbs gently tacked to each other. While only a theory, it seems plausible that the negative wound healing effects of smoking related to vasoconstriction may be less pronounced in the absence of further vascular compression caused by any tension on closure.

Finally, an increased rate of both projection-related and other complications was seen with the use of the skate flap compared to the star flap. This may be due to the use of a skin graft from the groin with the skate flap, a typically more bacteria-ridden location. It also requires a successful skin graft in addition to the survival of the local flap. Furthermore, the surgeons at our institution utilizing the skate flap report that excessive projection is intentionally created at the time of initial reconstruction with a plan for revision to decrease projection when the natural loss of projection postoperatively is inadequate. The need for secondary procedures to reduce projection, may account for the increase in other complications seen as well.

While limited by its retrospective nature and the need to categorize complication groups for statistical analysis due to the low rates of the individual complication types, we feel that this study may be useful in counseling patients unsure about proceeding with nipple reconstruction. Those individuals with a history of radiation and implant-based reconstruction, especially with a history of medical comorbidities associated with a negative effect on wound healing, should be advised that they may be at higher risk for nipple reconstruction complications. All patients with implant-based breast reconstruction considering nipple reconstruction should be informed that, while generally well tolerated with infrequent and usually minor complications, there is a risk of implant loss related to problems following nipple reconstruction.

**CONCLUSIONS**

Chest-wall radiation and implant-based reconstruction are associated with higher rates of nipple reconstruction problems. Identification of patient and surgical variables associated with increased risk of poor outcomes preoperatively could help in patient counseling and selection of the most appropriate method of breast and nipple reconstruction.

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