Solar Burns to the Reconstructed Breast: A Rare Complication following Breast Reconstruction

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INTRODUCTION

The radiated, reconstructed breast is susceptible to postsurgical complications with the majority of these occurring in the immediate perioperative period. Burns to the reconstructed breast, while rare, can present as a delayed complication resulting from contact/conductive, radiant, or solar exposure. Solar burns have been described as the second most common cause of burns in both autologous and implant-based breast reconstruction in the literature. Solar burns in autologous and alloplastic breast reconstruction, while rare, pose significant complications in the reconstructed breast and appear to be exacerbated by radiation and dark-colored clothing. Patients should be counseled accordingly with discussion of this potential risk in a comprehensive informed consent, and precautions should be recommended to avoid this type of injury.

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Herein, we include a literature review of solar burns to the reconstructed breast to help determine risk factors and increase awareness of this rare potential complication. In addition, we describe a case of full-thickness solar burn to the breast 8 years after IBR. The method of reconstruction included fat grafting to improve skin quality, repeat expansion, and replacement of implant.

**PATIENTS AND METHODS**

A literature search was performed to identify publications regarding solar burns in autologous and alloplastic breast reconstruction. The PubMed search engine was used; key words included “burn” AND “reconstructed breast.” The abstracts of the articles were screened, and the articles not relevant to burns on the breast following breast reconstruction were excluded. All publications with solar burns in autologous or IBR were included. Solar burns included those caused by sunbathing or by sun lamp. Autologous breast reconstruction included patients who underwent deep inferior epigastric perforator (DIEP) flap, free or pedicled transverse abdominis musculocutaneous (TRAM) flap, or latissimus dorsi (LD) flap. Thoracodorsal artery perforator (TAP) flaps with implant and acellular dermal matrix were also included and characterized as autologous breast reconstruction. IBR included patients who received direct to implant or tissue expander followed by implant without any regional or free flaps. Literature reviews, case reports, case series, and letters to the editor were included. Excluded were patients without burns on the breast or those caused by other methods such as conduction (heating pads, hot water bottles, or hot liquids) or convection (hair dryers and warming lamps). Additionally, non-English articles were excluded. In the remaining articles, review of the bibliography for each article resulted in additional relevant articles.

Data gathered included patient’s age, reconstructive method, history of radiation therapy, time from reconstruction to burn, duration of sun exposure, type of clothing, burn thickness, burn description, burn treatment, and outcome. In publications that satisfied our inclusion criteria but with limited or missing data, the data were included if available.

**CASE REPORT**

We present the case of a 41-year-old, healthy, nonsmoking woman with Fitzpatrick type 3 skin who developed right-sided invasive ductal carcinoma and underwent bilateral skin-sparing mastectomy and reconstruction with subpectoral tissue expander placement. The initial surgery was followed by 12 weeks of adjuvant chemotherapy and 28 fractions of radiation (50.4 Gy of radiation localized to the right breast and chest wall, 45 Gy localized to the right supraclavicular fossa and posterior axilla). Eight months after the initial surgery, the tissue expanders were exchanged with 750-mL smooth, round implants. She then underwent nipple areolar complex reconstruction with CV flaps followed by tattoo. Four years later, due to continued radiation changes, she underwent minor revision of the right breast with capsulotomy and lowering of the inframammary fold (Fig. 1).

Postoperatively, she did well until 4 years after her last surgery (eight years after the initial surgery). The patient sat in the sun in a new black-colored polyester bathing suit for approximately 2 hours. That evening, she noticed severe blistering on the right breast mound in the area that was covered up by the bathing suit (Fig. 2). She was wearing sunscreen over the remainder of her skin and had no burns elsewhere including the exposed, also irradiated, skin surrounding the bathing suit, or the contralateral breast. She presented to the emergency department that evening and to clinic 3 days later where she was diagnosed with a partial thickness burn. This was managed initially with Xeroform and bacitracin dressing changes, however, the burn progressed to full-thickness (Fig. 3). Due to the large area of full-thickness burn and subjective fevers, the patient was offered excision of the burn with reconstruction using autologous versus staged IBR.

The patient wished to undergo surgery with IBR. To get her closer to her preoperative size, we discussed the need for repeat expansion as well as fat grafting to

**Takeaways**

**Question:** What risk factors are associated with solar burns in breast reconstruction?

**Findings:** Solar burns presented with higher incidence following autologous breast reconstruction, history of radiation, and dark clothing. Alloplastic breast reconstruction required surgical debridement more frequently than autologous breast reconstruction.

**Meaning:** Breast reconstruction patients should be counseled regarding the incidence, complications, and risks of solar burns.

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**Fig. 1.** Patient’s final reconstruction 2 years before burn injury. This image was 2 years postoperative from nipple areolar complex reconstruction with CV flap and tattooing and lowering of the left inframammary fold.
improve the quality of the radiated skin. The burn was excised and the breast implant was removed. Fat was harvested from her abdomen using liposuction. The fat was separated with Telfa (Covidien LLC, Mansfield, Mass.) and 138 mL was injected into the mastectomy skin flaps and pectoralis muscle using a Coleman technique. The mastectomy flaps were closed primarily over a partially filled tissue expander.

The patient underwent several rounds of tissue expander filling in the office and 2 months later she returned to the operating room for removal of the expander with placement of smooth round implant. Repeat fat grafting with 20 mL of abdominal fat was performed on the right breast as well as a left-sided Ryan flap and implant exchange for symmetry. The patient went on to heal with no major complications. Her wounds healed and she had improved pain and symmetry (Fig. 4).

**RESULTS**

The literature search identified 598 publications. Review of the abstracts revealed 27 relevant articles. Twenty-two cases of solar breast burns after reconstruction were identified from 12 articles. The mean age of all patients was 51 years old. The age of the patient population ranged from 24 to 71 years old.

Eighteen of the 23 (78%) solar burns were described in autologous breast reconstruction. Of the autologous flaps, 11 (61%) were TRAM flaps, four (22%) DIEP flaps, two (11%) TAP flaps, and one latissimus (6%). Most of the TRAM flaps were pedicled (9, 82%). Ten of the 23 (43%) solar burns occurred in the first 6 months, and an additional eight (78%) patients developed solar burns which occurred within the first 2 years. Fourteen of these patients (78%) went on to heal within 3 weeks to 4 months; however, four patients (22%) required surgical debridement with skin grafting. Nine patients (50%) were noted to be
## Table 1. Summary of Peer-reviewed Literature of Solar Burns in Autologous and Implant-based Breast Reconstruction

| Reference | Year | Patient Age, y | Reconstructive Method | Radiation Therapy | Reconstruction to Burn Time | Method of Exposure | Duration of Exposure | Type of Clothing | Burn Thickness | Burn Description | Treatment | Time to Healing |
|-----------|------|----------------|------------------------|-------------------|-----------------------------|-------------------|-------------------|------------------|----------------|-----------------|-----------|-----------------|
| Maxwell & Tornambe | 1989 | 48 | Pedicled TRAM | Unknown | 1 y | Sunlamp | Unknown | No clothing | Partial | L breast | Topical silvadene BID with debridement | 3 mo |
| Lejour | 1996 | Unknown | Unilateral implant | Yes | 7 mo | Sun exposure | N/A | Dark clothing | Full | 4 cm | Topical silvadene BID with debridement | Unknown |
| Alexandrides et al | 1997 | Unknown | TRAM flap | Unknown | 1 y | Sun exposure | Unknown | Unknown | Partial | Unknown | Implant exchange, LD | Unknown |
| Beckenstein et al | 1997 | 42 | Bilateral pedicled TRAM | Unknown | 10 d | Sun exposure | Unknown | Black bathing suit | Deep | 48 and 44 cm² | Excision and split-thickness skin graft | Unknown |
| Nahabedian & McGibbon | 1998 | 24 | TRAM | Unknown | 6 mo | Sunbathing | Unknown | Dark clothing | Full | 2 × 6 cm | Dressing changes; permanent scarring | Unknown |
| Davison | 1999 | 52 | Pedicled TRAM | No | 10 mo | Sun exposure | Unknown | Bathing costume | Full | Overlying flap | Dressing changes and topical chloramphenicol/collagenase | 2 mo |
| Delfino et al | 2009 | 44 | Pedicled TRAM | Yes | 8 mo | Sun exposure | Some hours | Black polypropylene | Full | Inferior flap 12 × 8 cm | Dressing changes with paraffin gauze | 4 mo |
| Enajat et al | 2009 | 54 | DIEP | Unknown | 6 wks | Sun exposure | 2 h | Black polypropylene | Full | Inferior flap 7 × 5 cm | Dressing changes with paraffin gauze | 3 mo |
| Mahajan et al | 2010 | Unknown | LD | Yes | 7 wks | Sun exposure | 45 min | Black shirt | Deep | Partial | Daily wound care including hydrogel, hydrofera blue, and aquaphor with hyperbaric oxygen therapy | Unknown |
| Børsen-Koch et al | 2016 | 61 | TAP flap, 575 mL silicone implant and ADM (TAPIA) | No | Unknown | Sun exposure | Unknown | Black top Black T-shirt | Full | Unknown | Debridement, split-thickness skin graft | Unknown |
| Nigro et al | 2018 | 71 | Direct to implant textured silicone implant, prepectoral with ADM | Yes | 7 wks | Sun exposure | 45 min | Black camisole | Full | Unknown | Debridement, negative pressure wound therapy | Unknown |
| Saadeh et al | 2020 | 64 | DIEP—R, unilateral | Unknown | 2 y | Sun exposure | Unknown | Unknown | Deep | Partial | Local wound care, hydrogel | Unknown |
| Romanelli et al (current study) | 2021 | 41 | Submuscular tissue expander, smooth round implants | Yes | 8 y | Sun exposure | 2 h | Black polypropylene | Full | 15 × 6.5 cm | Excision with primary closure, fat graft and staged implant-based reconstruction | Unknown |
wearing dark clothing, two were wearing no clothing, and seven are unknown or not documented.

Five solar breast burns (22%) occurred in patients after alloplastic breast reconstruction. The four cases in the literature (80%) occurred within 7 months of the patient’s reconstructive surgery; however, in the case we described, this occurred 8 years after her implant placement. Two burns occurred over a tissue expander (40%) and three over a permanent implant (60%). Four of the five alloplastic cases (80%) received radiation (with the other undocumented) and two (40%) required implant removal and further surgical reconstruction. All five of these burns (100%) occurred through the patient’s dark-colored clothing.

**DISCUSSION**

Solar burns to the breast after reconstruction remain a rare, often overlooked, and potentially devastating complication after breast reconstruction. Susceptibility of the breast to thermal injury is likely multifactorial, including factors such as radiation, history of tissue expansion, and clothing color.\(^1\)\(^8\) Perhaps, the most important factor common to most solar burns in reconstructed breasts is a dark-colored garment. The color black absorbs all wavelengths of light and reflects none; thus, more energy is absorbed. The darker the color, the more heat is generated against radiated, expanded, or insensate skin which is already less equipped to handle these thermoregulatory challenges. Radiation causes DNA damage and histologic changes in the skin and soft-tissue microvasculature, leading to impaired thermoregulatory response to heat stress.\(^6\)

Additionally, tissue expansion can decrease the thickness of the dermis, possibly altering the ability of the flaps to resist heat.\(^19\)

Limited or absent sensation of the skin following breast reconstruction is thought to be due to the sacrifice of sensory nerves during the mastectomy, which therefore reduces the patient’s ability to detect solar heat.\(^20\) Some mastectomy flaps partially regain protective sensation over the course of a few years, but this recovery is variable and unpredictable.\(^20\) A comparison of nipple-sparing mastectomy has shown improved light touch and pleasure sensation relative to skin-sparing mastectomy, which could lead to a reduced incidence of thermal injury in nipple-sparing mastectomy relative to skin-sparing mastectomy.\(^21\)

Unfortunately, our literature review possessed limited data with regard to the type of mastectomy.

Incidence of solar burns in the literature was found to be higher in autologous breast reconstruction when compared with implant-based reconstruction based on our findings illustrated in Table 1. Within autologous reconstruction, DIEP flaps recover in the most sensitive manner, followed by TRAM flaps, and then LD flaps.\(^22\)

One hypothesis proposed is the delay in neural healing across the thickness of autologous flap tissue relative to implant-based reconstruction with tissue expanders.\(^23\)\(^25\) This could also be explained by the improved sensation in implant-based reconstruction relative to autologous breast reconstruction.\(^24\)\(^25\) For this is due to nerves’ more rapid growth through native tissue when compared with crossing through to the flap.\(^20\) The lack of neural regeneration early in the reconstructive process may be why previous reports suggest solar burns in IBR are an earlier postoperative complication (within first 6 months). Some patients such as those described in this report, however, may not regain complete sensation, leaving them susceptible to such injury even years later.\(^20\)

One limitation of this study is the potential for reporting bias given the nature of the systematic review of prior literature. This could also be the reason for our increased incidence of solar burns in autologous breast reconstruction. Additionally, our study was limited in that prior studies did not characterize whether skin-sparing or nipple-sparing mastectomy had been performed before reconstruction.

In conclusion, although there are few reports of sunburn following IBR, this problem will continue to occur with the increase in breast reconstruction without proper informed consent. IBR remains the most common type of breast reconstruction and patients must realize that complications can extend beyond the immediate perioperative period. Patients should be aware that this potential complication can occur years after reconstruction. Solar injury to the skin is a known harm, but appears to be of greater risk in breast reconstruction patients lacking protective sensation. High-risk patients, such as those with radiated skin and less than 1 year out from surgery, should apply sunscreen to unexposed skin, avoid dark clothing over the breasts, and diligently check their skin even after short periods of exposure to the sun. Although a rare complication, we believe the incidence and prevention strategies of potential burn injury should be included in informed consent for both implant-based and autologous breast reconstruction.

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