International Journal of Multiphysics
Volume 18, No. 3, 2024
ISSN: 1750-9548

Skin-Sparing Mastectomy and Goldilocks Mastectomy for Breast Cancer

Mohamed Hosam Habashy[1], Osama Eltih[1], Hassan Ashour[1], Mohamed Adel Saqr [2], Mohamed S Bayomi[1] , Mohamed Shehata[1]

[1] Department of General surgery, Faculty of Medicine, Zagazig University, Egypt

[2]Department of Plastic & Reconstructive surgery, Faculty of Medicine, Zagazig University, Egypt

***Corresponding author: Mohamed Hosam Habashy**

E-mail: mohamed.hosam007@gmail.com

Abstract:

Skin-sparing mastectomy represents a new surgical approach that allows a mastectomy while preserving the natural skin envelope of the breast. It facilitates immediate breast reconstruction using an implant or myocutaneous flap, resulting in excellent cosmesis.

Keywords: Skin-sparing Mastectomy, Goldilocks mastectomy, breast cancer.

Introduction:

In June 1991, Toth and Lappert first used the term skin-sparing mastectomy‖ for immediate reconstruction, and around the same time, Kroll et al. published the MD Anderson experience in 100 cases using the same technique. These reports led to the start of an interesting discussion on the improvement of cosmetic results and parallel doubts regarding local disease control. But this story actually begins here, but before and serendipity. Barton et al. has a job where I wanted to test the hypothesis insecurity of prophylactic mastectomies [retaining skin and nipple areola complex (NAC)] with the assumption that these glandular residue left over that year **(1).**

A comparison with conventional cancer mastectomies (without skin sparing) performed by trained surgeons of the same institution revealed persistent gland flaps, sub-mammary furrow, and axillary extension, taking these samples to independent surgeons who conducted the primary resection. Contrary to expectations, the rates of glandular residue were similar between the two groups (21% with therapeutic mastectomy versus 22% with prophylactic surgery), which raised questions as to the value of prophylactic surgery and the effectiveness of conventional radical methods**(2).**

This experience, in parallel with the first publication on immediate breast reconstruction mastectomies, marked the start of the SSM era, and a new horizon had been set for good cosmetic results and oncological safety. With the discovery of mutations to BCRA1 (9) and BRCA2 (10) oncogenes in 1994 and 1995, respectively, and their association with high breast cancer risk, new preventative measures were advocated for high-risk patients. First, preventative and therapeutic indications were postulated in an attempt to not only retain the skin but also the NAC. This therapeutic approach is the subject of ongoing controversy **(3).**

Definitions and classifications

Skin sparing mastectomy defined as a simple or radical surgery with modified minimal incisions that retain the widest possible coverage and sub-cutaneous breast groove but dry the NAC, flaws of previous biopsies and/or scarring caused by diagnostic percutaneous biopsies. Access to the armpit for a possible

sentinel-node biopsy or axillary dissection is obtained through the same incision. An additional incision may be necessary to perform the reconstructive procedure (e.g., microsurgical axillary anastomosis). SSM is classified into the following five types **(Fig. 1) (4):**

- **a.** NAC peri-areolar resection or losangic resection of breast skin.
- **b.** Resection of the NAC with medial or lateral extension and previous biopsy scar resection.
- **c.** NAC peri-areolar resection and incision for resection of previous biopsy scar.
- **d.** Elliptical, wider resection of skin including the NAC aimed at reducing ptosis (indicated in ptotic and hypertrophic breasts).
- **e.** Resection of skin and CAP with inverted T pattern (indicated in ptotic and hypertrophic breasts).

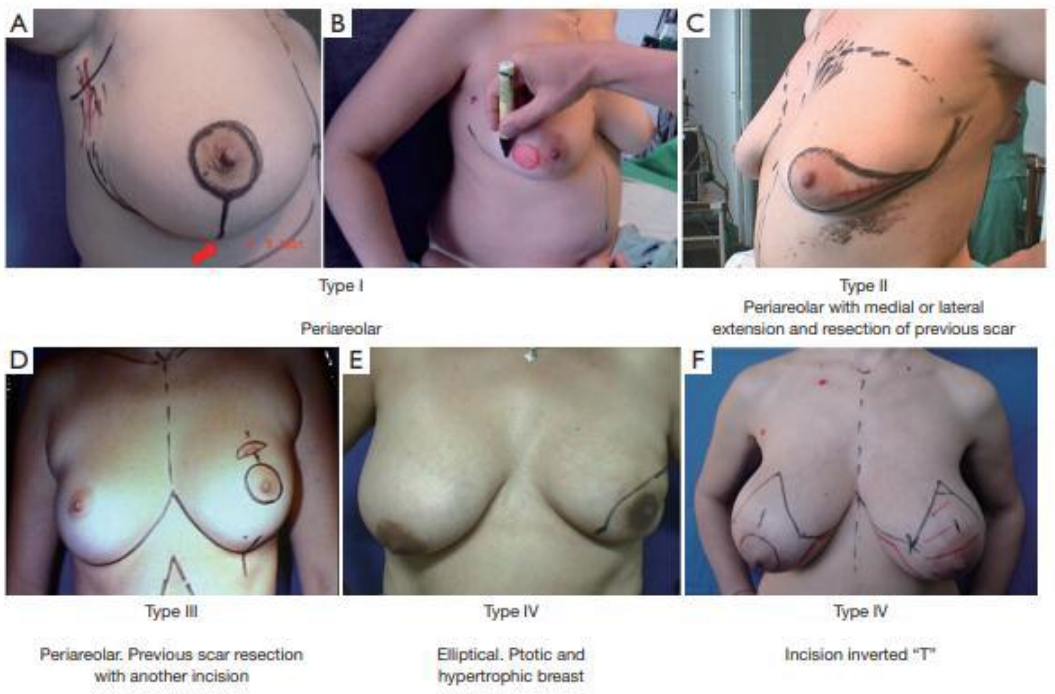

Figure (1): Skin sparing mastectomies. Classification: (A,B) Incision type I; (C) incision type II; (D) incision type III; (E,F) incision type IV **(5).**

Indications

SSM can be performed in patients requiring mastectomy for: ductal carcinoma in situ; stage I-II infiltrating breast carcinomas [the Union for International Cancer Control and American Joint Committee on Cancer (UICC/AJCC)], and in much selected cases, stage III; and local recurrences (LRs) after conservative treatment, when the skin has a slight heating sequel. Contraindications for SSM include: inflammatory carcinomas, locally advanced carcinomas, and smoking (relative contraindication) **(6).**

Surgical technique

For good outcomes with a low complication rate, it is necessary to consider the fundamental aspects of this technique. First, the incision must be designed depending on the presence or absence of scars after excisional biopsy or puncture, as well as breast volume and ptosis. In type I SSM **(Fig. 2)**, a 5-mm incision is made from the edge of the NAC with its surroundings marked, and a second transverse axillary incision can be made for axillary dissection or a possible microsurgical anastomosis. Some situations may require the peri-

areolar incision to be extended into the armpit or to the 6 o‘clock position to facilitate performance of the reconstruction technique **(7).**

In type II, contemplates inclusion in NAC incision and scar prior continuity being designed in particular according to the present scar. In type III SSM, the incisions for NAC resection and previous scar are designed separately, to allow a ―bridge‖ between both cutaneous non-small margins and avoid possible loss of vitality. Types IV and V are for ptotic breasts, when correction of the asymmetry of the opposite breast is considered, and can be used with elliptical skin resection or incision techniques such as the inverted "T" resection performed bilaterally for the NAC **(8).**

The dissected mastectomy flaps require a more detailed explanation as they are the key factors in this surgery from the oncological as well as postoperative vitality perspectives. The dissection must be meticulous, and the flaps must be of uniform thickness to avoid trauma with spacers. Very thin flaps do not increase oncological safety and are associated with a higher incidence of skin necrosis **(9).**

Previous anatomical studies have shown that only 56% of patients have superficial layer of the superficial fascia, which facilitates dissection, but the remaining 44% is difficult to perform this surgical technique. Moreover, in both cases, there may be a mammary gland near the dermis, making it virtually impossible to complete removal of the breast tissue without compromising the vitality of the flaps**(10).**

Breast resection is performed using conventional techniques such as axillary dissection or sentinel-node biopsy, which preserve the structure and the sub-groove (groove in the sub-mammary gland) where occurrence of disease is rare. The resected tissue should be examined by a pathologist in the operating room, orient, make a mammography, especially in the breast tissue surrounding the tumor and confirm that it is free of disease. Otherwise, the surgeon should expand the cutaneous resection. This examination is especially important for in situ carcinomas, and it decreases the risk of LR **(11).**

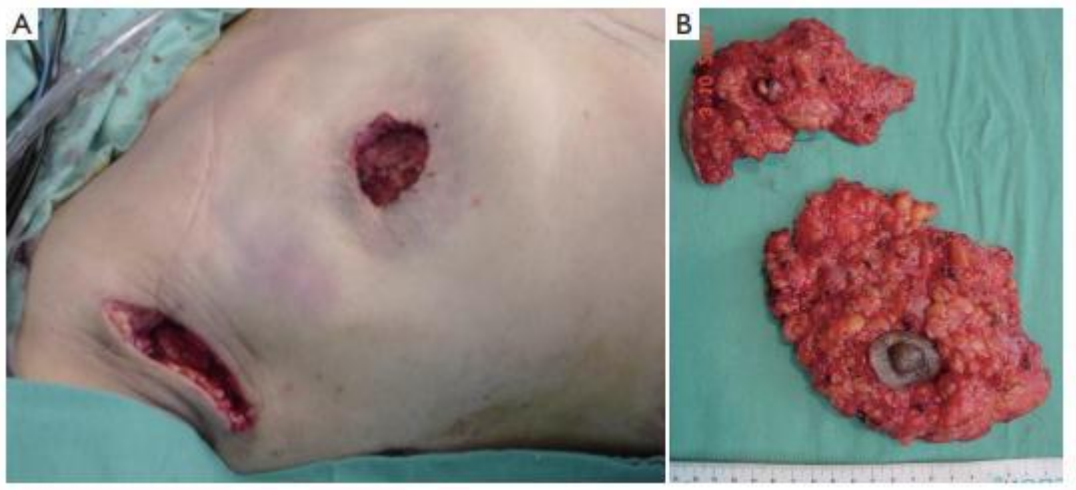

Figure (2): Skin-sparing mastectomy type I (periareolar) and axillary dissection.
(A) Conservation of cutaneous pocket and the submammary fold, preserving the anatomical limits; (B) mastectomy and axillary dissection specimen **(12).**

The four primary reconstruction techniques used are: TF, pedicled or a microsurgical flap such as the DIEP flap; temporary or definitive anatomical expanders, with prosthesis indicated exceptionally; extended latissimus dorsi flap; latissimus dorsi flap over prosthesis or expander. Complications: Necrosis of the mastectomy flaps is an important complication and requires extensive care. Avoiding necrosis is crucial for the final cosmetic result, especially if the reconstruction is performed with an expander and/or prosthesis, where this

complication may cause extrusion and failure of the procedure. Necrosis is prevented with meticulous preparation of the mastectomy flaps, which is necessary to optimize the outcomes of the surgical technique **(1).**

The flaps must be of a uniform thickness to prevent devitalization. In patients in whom SSM and placement of expanders are indicated, especially in those with an increased risk of necrosis due to special circumstances such as tobacco use, it is important to cover the implant with a complete muscular pocket or use acellular dermis to minimize the consequences of a skin complication **(12).**

If necrosis occurs, whether or not muscular coverage was provided, further surgical exploration is indicated to prevent the loss of the implant. According to a protocol described in recent publications. The patient's smoking status must also be assessed with regard to the reduction of necrosis **(5).**

Nicotine is a direct vasoconstrictor that affects the skin; it has an indirect effect on the production of capillary flow by inhibiting release of catecholamines. Non-smoking status is therefore preferred (relative contraindication). Radiotherapy influences various aspects of surgical planning and outcome. When performed before surgery, it can negatively influence the final aesthetic result and increase the rate of complications (necrosis of skin flaps). When used as an adjuvant treatment or for a LR, it can worsen the aesthetic result according to the type of reconstructive technique employed **(12).**

Therefore, in general, in patients who have undergone previous irradiation and SSM, reconstruction techniques such as DIEP flap and TF are preferred to improve outcomes and favorably influence the preserved skin by preventing necrosis, as these minor procedures help maintain the cosmetic results. In previous publications, flap necrosis has been reported in 5.6-8% of conventional mastectomies. In SSM, it has been reported in 3-15% of cases depending on the series. In previous experience, the incidence of flap necrosis was relatively low, at 5.6% (26), possibly related to the care taken in patient selection and optimization of the surgical technique **(1).**

Radiotherapy and skin-sparing mastectomy

The majority of women undergoing mastectomy do not require postoperative radiotherapy. However, patients with at least four positive regional lymph nodes or large (5 cm) tumors are offered such treatment because it reduces the incidence of locoregional recurrence and improves survival. Consequently, radiotherapy is indicated in some women who have undergone SSM and immediate breast reconstruction **(13).**

Postmastectomy radiotherapy is, however, associated with local complications, thus causing some debate as to the safety of performing SSM and immediate breast reconstruction in women who will require postmastectomy radiotherapy. The complication rate of radiotherapy after autogenous reconstruction varies from 5% to 16%, the most common complications being fat necrosis (16%) and radiation fibrosis (11%), although the latter study included only 19 patients who had undergone TRAM flap reconstruction **(7).**

These complications may cause subsequent shrinkage of the reconstructed breast. Indeed, some surgeons deliberately oversize the reconstruction if radiotherapy is anticipated. The main concern regarding radiotherapy in the reconstructed breast, however, is related to the use of implants, either alone or in conjunction with a flap reconstruction. Evans et al compared 39 irradiated implant reconstructed breasts with 338 nonirradiated reconstructions and showed a significant negative effect on the reconstructive outcome with implants. The main complications were capsular contracture and postoperative pain **(14).**

The majority developed contracture and 43% underwent a subsequent capsulotomy. In view of this, many surgeons encourage women who are likely to need postoperative radiotherapy, such as those with clinically involved nodes or a positive SNB, to undergo a delayed breast reconstruction. This approach would mean that these women would not be able to undergo SSM. However, it has been suggested that a SSM can be

performed in these patients if a temporary tissue expander is placed under the skin envelope deep to the pectoralis major muscle. After radiotherapy, the delayed reconstruction can be carried out using a myocutaneous flap after removing the tissue expander **(15).**

More specifically, Hultman and Daiza investigated the incidence and outcome of SSM flap complications after reconstruction. Transverse rectus abdominis myocutaneous and latissimus dorsi flaps and implant reconstructions were all included in this study. Nine of 37 (24%) had a SSM flap complication, in which 7 were cases of moderate or severe skin loss, 4 were dehiscences, and 5 required repeat operations. They found that previous irradiation (5 cases) and diabetes mellitus were significant risk factors for SSM flap complications, but they did not address the issue of postoperative radiotherapy **(16).**

Eleven patients in whom local recurrence developed after breast conserving surgery and whole breast radiation subsequently underwent SSM and immediate breast reconstruction, using either TRAM or latissimus dorsi flaps. All the flaps survived, 1 patient developed partial thickness SSM skin flap loss and 2 developed capsular contractures, demonstrating that SSM and immediate breast reconstruction can be safely performed in previously irradiated breasts. In addition, Benediktsson and Perbeck have shown that radiotherapy does not significantly compromise the skin circulation of the breast. Therefore, as long as a slightly higher complication rate is accepted, it appears safe for women to undergo SSM and immediate breast reconstruction in previously irradiated breasts in the majority of cases. However, larger studies with longer follow-up are required to confirm this observation **(13).**

Goldilocks Mastectomy

The increased rates of obesity coupled with the increased rate of breast cancer development in the obese has resulted in a patient population for whom there are few reconstructive options after mastectomy. Multiple studies have shown unacceptable complication rates for both prosthetic and autologous reconstruction in these patients. These complications include implant and flap loss and reconstructive failure, skin necrosis, wound complications, fat necrosis, and donor-site complications. Goldilocks mastectomy was developed for patients who were poor candidates for traditional postmastectomy reconstruction **(17).**

The storybook character "Goldilocks" was presented with a variety of choices. She did not want anything that was "too hot" or "too cold". She did not want anything that was "too hard" or "too soft". She chose the midway option that was a compromise of both extremes. So, the term Goldilocks was proposed for a satisfying option while avoiding extremes **(18).**

This technique involves a skin-sparing mastectomy through Wise incisions and utilizes the residual cutaneous mastectomy flaps to create a breast mound. In the minority of women with significant macromastia and ptosis, this might allow for a single-stage autologous reconstruction. Most women require additional volume supplementation, some of whom can be accommodated with lipotransfer surgery **(19).**

However, most obese women require significant additional volume that must be supplied by an implant or flap. In these women, Goldilocks mastectomy with free nipple grafts was followed by definitive submuscular implant placement 3 months later without an instance of reconstructive failure or significant complication that delayed care **(20).**

Surgical Technique

Preoperative markings:

The patient is marked preoperatively in a standing position. The breast meridian and inframammary folds are marked on both sides. The apex of the reduction pattern is marked along the breast meridian as it

projects anteriorly from the level of the inframammary fold (IMF). This measures between 22 and 25 cm, depending on the patient's breast size and shape. The vertical limbs are drawn at an 80 degree angle, 8 cm in length. The medial horizontal line is drawn and connected to a point marked about 3 cm medial to midline and the lateral horizontal line is drawn and connected to a point where the inframammary fold crosses the anterior axillary line **(18).**

Intraoperative approach:

The mastectomy is performed through either a circumareolar incision or an ellipse, depending on the breast configuration **(Fig. 3).** All grossly visible breast parenchyma is removed while maintaining adequate perfusion to the skin flaps. When necessary, sentinel lymph node biopsy and/or axillary dissection is carried out through the same incisions. Sharp dissection is then used to de-epithelialize the lower pole fasciocutaneous flaps inside the boundaries of the Wise pattern incision. The upper and lower poles are then sharply divided from one another. The lower pole tissue is rested on the chest wall in a semblance of a mound. The remaining skin envelope is closed using the standard Wise-pattern with the most inferior portion of the upper pole sutured to the limit of de-epithelialized dermis of the lower pole **(18).**

The median point to which the inverted T-junction is affixed is more medially oriented and tends to be 10-12 cm from the patient's midline. This prevents an excess of lateral tissue and capitalizes on reorienting the residual mastectomy flap tissue medially and superiorly to produce medial cleavage. Length of the de-epithelialized flap varied from patient to patient, extending from the IMF to the inferior areolar margin. If vascularity of the distal flap appears compromised, it is excised. Additionally, the medial and lateral extent of the superior horizontal limbs is not incised all the way to the IMF incision, thereby preserving the subdermal plexus from the surrounding skin. Taking care to leave the patient with well perfused flaps **(18).**

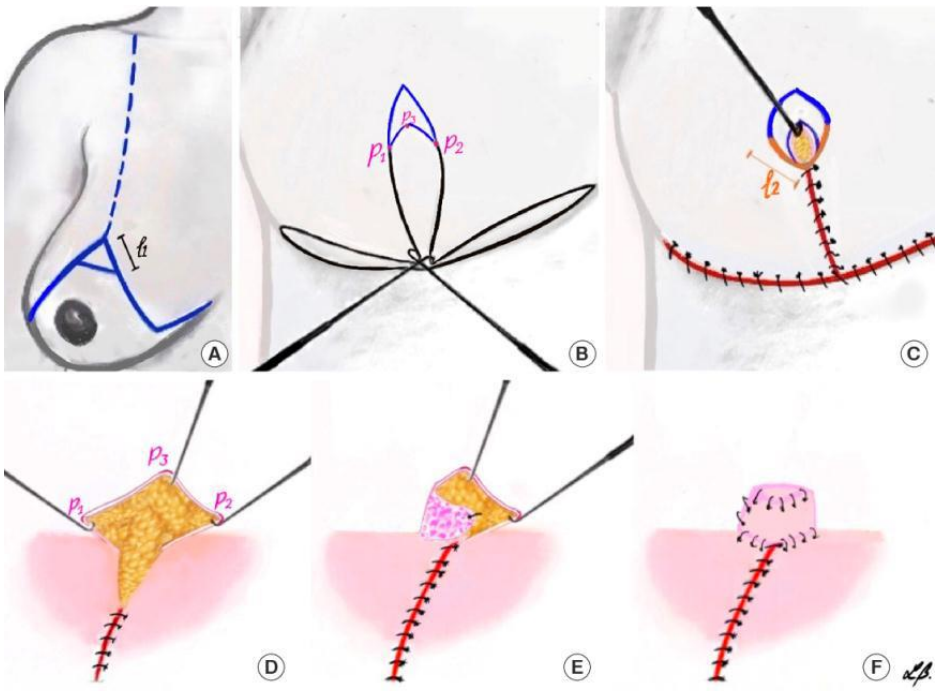

Figure (3): Intraoperative approach **(21).**

The procedure gives a midway solution for patients candidates for conservative mastectomy and not fit for common oncoplastic surgeries.

REFERENCES:

1. Galimberti V, Vicini E, Corso G, Morigi C, Fontana S, Sacchini V and Veronesi P (2017): Nipple-sparing and skin-sparing mastectomy: review of aims, oncological safety and contraindications. The Breast, 34: 82-84.
2. Agha RA, Al Omran Y, Wellstead G, Sagoo H, Barai I, Rajmohan S and Rusby JE (2019): Systematic review of therapeutic nipple-sparing versus skin sparing mastectomy. *BJS open*, 3(2): 135-145.

3. Rinker B (2016): A comparison of methods to assess mastectomy flap viability in skin-sparing mastectomy and immediate reconstruction: a prospective cohort study. *Plastic and reconstructive surgery*, *137*(2): 395-401.

4. Peled AW, Wang F, Foster RD, Alvarado M, Ewing CA, Sbitany H and Esserman LJ (2016): Expanding the indications for total skin-sparing mastectomy: is it safe for patients with locally advanced disease?. *Annals of surgical oncology*, *23*(1): 87-91.

5. Agha RA, Wellstead G, Sagoo H, Al Omran Y, Barai I, Rajmohan S and Rusby JE (2016): Nipple sparing versus skin sparing mastectomy: a systematic review protocol. *BMJ open*, 6(5): e010151.

6. van Verschuer VM, Mureau MA, Gopie JP, Vos EL, Verhoef C, Menke-Pluijmers MB and Koppert LB (2016): Patient satisfaction and nipple-areola sensitivity after bilateral prophylactic mastectomy and immediate implant breast reconstruction in a high breast cancer risk population: nipple-sparing mastectomy versus skin-sparing mastectomy. *Annals of Plastic Surgery*, *77*(2): 145-152.

7. Marta GN, Poortmans P, de Barros AC, Filassi JR, Junior RF, Audisio RA and Hijal T (2017): Multidisciplinary international survey of post-operative radiation therapy practices after nipple-sparing or skin-sparing mastectomy. *European Journal of Surgical Oncology*, *43*(11): 2036-2043.

8. Timbrell S, Al-Himdani S, Shaw O, Tan K, Morris J and Bundred N (2017): Comparison of local recurrence after simple and skin-sparing mastectomy performed in patients with ductal carcinoma in situ. *Annals of surgical oncology*, *24*(4): 1071-1076.

9. Corban J, Shash H, Safran T, Sheppard-Jones N and Fouda–Neel O (2017): A systematic review of complications associated with direct implants vs. tissue expanders following Wise pattern skin-sparing mastectomy. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, 70(9): 1191-1199.

10. Headon H, Kasem A, Manson A, Choy C, Carmichael AR and Mokbel K (2016): Clinical outcome and patient satisfaction with the use of bovine-derived acellular dermal matrix (SurgiMend™) in implant based immediate reconstruction following skin sparing mastectomy: a prospective observational study in a single centre. *Surgical Oncology*, *25*(2): 104-110.

11. Swetter SM, Tsao H, Bichakjian CK, Curiel-Lewandrowski C, Elder DE, Gershenwald JE and Lamina T (2019): Guidelines of care for the management of primary cutaneous melanoma. *Journal of the American Academy of Dermatology*, *80*(1): 208-250.

12. Stratigos AJ, Garbe C, Dessinioti C, Lebbe C, Bataille V, Bastholt L and Grob JJ (2020): European interdisciplinary guideline on invasive squamous cell carcinoma of the skin: Part 1. epidemiology, diagnostics and prevention. *European journal of cancer*, *128*: 60-82.

13. Hehr T, Baumann R, Budach W, Duma MN, Dunst J, Feyer P and Sauer R (2019): Radiotherapy after skin-sparing mastectomy with immediate breast reconstruction in intermediate-risk breast cancer. *Strahlentherapie und Onkologie*, *195*(11): 949-963.

14. Zinzindohoue C, Bertrand P, Michel A, Monrigal E, Miramand B, Sterckers N and Lacombe S (2016): A prospective study on skin-sparing mastectomy for immediate breast reconstruction with latissimus dorsi flap after neoadjuvant chemotherapy and radiotherapy in invasive breast carcinoma. *Annals of surgical oncology*, *23*(7): 2350-2356.

15. Peled AW, Sears M, Wang F, Foster RD, Alvarado M, Wong J, Fowble B (2018): Complications after total skin-sparing mastectomy and expander-implant reconstruction: effects of radiation therapy on the stages of reconstruction. *Annuals of Plastic Surgery*, *80*(1): 10-13.

16. Barrou J, Bannier M, Cohen M, Lambaudie E, Gonçalves A, Bertrand P and Houvenaeghel G (2017): Pathological complete response in invasive breast cancer treated by skin sparing mastectomy and immediate reconstruction following neoadjuvant chemotherapy and radiation therapy: comparison between immunohistochemical subtypes. *The Breast*, 32: 37-43.

17. Schwartz JC (2017): Goldilocks mastectomy: a safe bridge to implant-based breast reconstruction in the morbidly obese. *Plastic and Reconstructive Surgery Global Open*, *5*(6): 1-4.

18. Richardson H (2020): Goldilocks Mastectomy. *Oncoplastic Breast Surgery Techniques for the General Surgeon*, 413.

19. Chaudhry A, Oliver JD, Vyas KS, Alsubaie SA, Manrique OJ and Martinez-Jorge J (2019): Outcomes analysis of Goldilocks mastectomy and breast reconstruction: a single institution experience of 96 cases. *Journal of Surgical Oncology,* 119(8): 1047-1052.

20. Richardson H and Aronowitz JA (2018): Goldilocks mastectomy with bilateral in situ nipple preservation via dermal pedicle. *Plastic and Reconstructive Surgery Global Open*, *6*(4): 1-3.

21. Shay P and Jacobs J (2018): Autologous reconstruction following nipple sparing mastectomy: a comprehensive review of the current literature. *Gland Surgery*, *7*(3): 316.