

Surgical Reconstruction Techniques after Mastectomy

¹Abdulkhikim Hadi Alshehri, ²Abdullah Mohammed Alqarni, ³ Ibrahim Ali I. Alasseri, ⁴Mohannad Ali Alomari, ⁵Sami saad al-shammari, ⁶Mohammad Balgaith Albareqi, ⁷Sultan Ali Alshehri

Abstract: Breast reconstruction has actually become a readily available option for a lot of females who need to undergo mastectomy. This review was aimed to focus in discussing the Reconstructive breast surgery after performing mastectomy, we intended to evaluate the surgical techniques and outcome of those reconstruction surgical intervention. Comprehensive electronic search through medical databases included Medline (using PubMed), PsycINFO, CINAHL, and the Cochrane Library relevant studies that were published until December 2016, in English language, concerning the breast reconstruction surgery after mastectomy. Improvements in autologous flap strategies, improvements in prosthetic innovations and the advancement of novel tissue substitutes have actually allowed for ongoing improvements in breast reconstruction results. In the future we can likewise anticipate that lots of new alternatives and strategies will have a substantial impact on reconstructive breast surgical treatment, consisting of nipple sparing mastectomy.

Keywords: Surgical Reconstruction, Mastectomy.

1. INTRODUCTION

Breast cancer is the leading reason for cancer death amongst females worldwide with ~ 1.7 million new diagnoses and 521,900 deaths in 2012 ⁽¹⁾. One important technique of breast cancer treatment is surgical treatment, which has actually ended up being progressively less mutilating over the last century ⁽¹⁾. William Halsted presented radical mastectomy including resection of the breast and its hidden pectoralis major muscle in order to cure all phases of breast cancer at the end of the in 1889 as a very aggressive way to surgically control the consisted of disease ⁽²⁾. Around 40 years later on, Patey described a less radical modified type of mastectomy with preservation of the pectoralis major muscle yielding similar local control and general survival compared to Halsted ⁽³⁾. In 1985, Fisher et al. presented the concept of breast saving therapy (BCT), demonstrating that lumpectomy by that time considered segmental mastectomy-- followed by adjuvant radiotherapy of the remnant breast in patients with phase I and II breast cancer was indeed associated with an increased local reoccurrence rate, yet resulted in equivalent survival rates compared to mastectomy ⁽⁴⁾. Oncoplastic breast surgical treatment, i.e., improving of the breast after local tumor resection, has actually revealed to enable bigger tumor excision, yet saving big parts of the breast, keeping shape ⁽⁵⁾ and leading to improved lifestyle and self-esteem ⁽⁶⁾.

Breast reconstruction has actually become a readily available option for a lot of females who need to undergo mastectomy ^(7,8,9). Reconstruction may happen immediately following removal of the breast or part of the breast, or several months after on completion of adjuvant treatment if needed. Some females might prefer to wait a number of years prior to considering a delayed breast reconstruction if at all. Every female needs to be to make an educated choice as to whether she has breast reconstruction when confronted with the need for mastectomy ⁽⁹⁾. Survey studies explain that an important factor in the choice of mastectomy is fear of recurrence, whereas a major factor of the option of breast conservation is concern about the cosmetic outcome ^(8,9). For those women who pick mastectomy as part of their technique to breast-cancer treatment or avoidance, reconstruction might be used as an option by the plastic and oncologic surgeons. The objective of reconstruction is to restore a breast mound and to maintain the quality of life without impacting the prognosis or detection of recurrence of cancer ^(10,11,12). This review was aimed to focus in discussing the Reconstructive breast surgery after performing mastectomy, we intended to evaluate the surgical techniques and outcome of those reconstruction surgical intervention.

2. METHODOLOGY

Comprehensive electronic search through medical databases included Medline (using PubMed), PsycINFO, CINAHL, and the Cochrane Library relevant studies that were published until December 2016, in English language, concerning the breast reconstruction surgery after mastectomy. Mesh terms was used in this search through mentioned databases: (quality of life OR outcomes OR results OR benefits OR satisfaction) AND (breast reconstruction OR breast implant OR patient satisfaction AND breast reconstruction; and mastectomy) AND breast cancer. Article references were hand-searched.

3. RESULTS

Mastectomy

Mastectomy focuses on resecting as much breast tissue as possible, knowing that glandular tissue will almost always remain in the region of the inframammary fold ⁽¹³⁾. Nowadays, basically 2 methods of mastectomy are performed, consisting of skin-sparing mastectomy and total ablation of the breast. The latter consists of complete elimination of both, breast skin and glandular breast tissue (**Figure1**) ⁽¹⁴⁾, whereas skin-sparing mastectomy protects as much of the breast's skin envelope as possible, consisting of the areola and the nipple (skin-sparing mastectomy, areola-sparing mastectomy, nipple-sparing mastectomy, skin-reducing mastectomy) and the inframammary fold. Additionally, biopsy scars and skin overlying a tumor and even penetrated by the tumor are excised in order to decrease the risk of local recurrence ⁽¹⁵⁾. Provided that the oncological indicator is appropriate, skin-sparing mastectomy has been connected with equivalent oncological local safety and enhanced esthetic outcome compared to modified radical mastectomy ⁽¹³⁾. Furthermore, the need for secondary surgery to change the contralateral breast in order to attain proportion is decreased after skin-sparing mastectomy, particularly if autologous reconstruction with flaps is used ⁽¹⁶⁾.

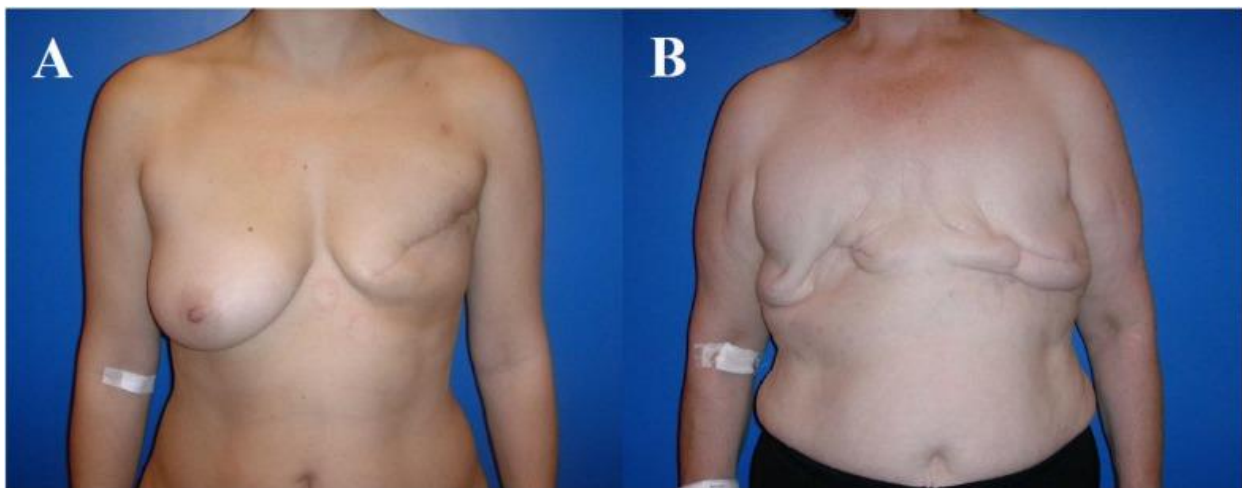


Figure1: The 43- and 63-year-old patients after modified radical mastectomy of the left breast (A), respectively, of both breasts (B). Indication for autologous reconstruction with a microvascular flap, particularly if skin and fat excess is available and adjuvant radiotherapy has been performed. ⁽¹⁴⁾

Surgical options techniques for breast reconstruction after Mastectomy

Recent advances in prosthetic and biologic implants, integrated with improvements in reconstructive flap procedures, have actually expanded surgical options for females who chose breast reconstruction following mastectomy. Each technique provides distinct advantages and drawbacks. Improving quality, by decreasing problems and appropriate patient choice, is very important as it has been revealed to be associated with higher patient complete satisfaction ⁽¹⁰⁾. The overriding objective of reconstructive breast surgical treatment is to carry out a safe operation that can restore self-image. Reconstructive in nature, breast reconstruction is achieved based on aesthetic principles. When selecting the suitable operation ⁽¹⁰⁾, there are a number of variables that must be thought about. Patient-related factors consist of breast size, breast shape, body mass index (BMI), smoking cigarettes status, prior desires, surgical treatments and expectations. Oncologic factors consist of tumor size, nodal status and previous history of radiation treatment or its necessity after mastectomy. Surgeon-related factors might likewise be very important in the choice making process, such as the technical ability of the cosmetic surgeon to offer a variety of procedures in a naturally safe and effective manner. Breast

reconstruction following mastectomy is extensively practiced, this Panel acknowledges that patients must be offered the choice of having no reconstruction. Breast reconstruction following mastectomy supplies the physical benefit of not needing to wear an external prosthesis and can ease the negative influence on a patient's body image. Some females see their option of no reconstruction as positive and feel really comfortable with their bodies and their decision ⁽¹⁰⁾.

Breast Reconstruction Using Implants and Skin Expanders

The use of implants and skin expanders is not just the earliest method to reconstruct a breast but likewise the quickest and most likely simplest method of breast reconstruction. Appropriately, implant-based breast reconstruction is by far the most often utilized technique worldwide ^(17,18). The requirement for implant-based breast reconstruction is an adequate skin envelope that enables covering the implant that is usually presented in a submuscular airplane separating the medial insertions of the pectoralis significant muscle from the ribs.

Cronin and Gerow fathered the contemporary period of breast reconstruction with the intro of the silicone gel breast augmentation in 1963 ⁽¹⁹⁾. The common method of breast reconstruction was through a postponed insertion following mastectomy. The delayed method controlled up until a case of an immediate reconstruction was reported in 1971. Snyderman and Guthrie ⁽²⁰⁾ reported making use of a silicone breast implant put under the staying chest wall skin immediately following a mastectomy. This method was embraced and dominated the rest of the decade ⁽²¹⁾.

Improving on the fundamentals of the silicone implant, strategies continued to develop. Radovan explained using tissue growth for breast reconstruction ⁽²²⁾. From this introduction, a patient with a more comprehensive skin deficit might now be a candidate for reconstruction of her breast. In 1982, Radovan ⁽²³⁾ initially published his outcomes with skin expanders for breast reconstruction. He explained a technique to permit steady expansion of the skin to replace the tissue lost from mastectomies. This stimulated the usage and popularity of breast reconstruction using tissue expanders. Since then, numerous have detailed the use of various textures, sizes, shapes of tissue expanders. The implants are available in both, round and anatomical shape and vary in height, forecast, and width (profile). Implant-based breast reconstruction is utilized in females who do not want any extra scars (flap harvesting) (Figure 2) ⁽¹⁰⁾ or do not have any adequate flap donor site (e.g., lean patient, pre-existing scars, and medical conditions).

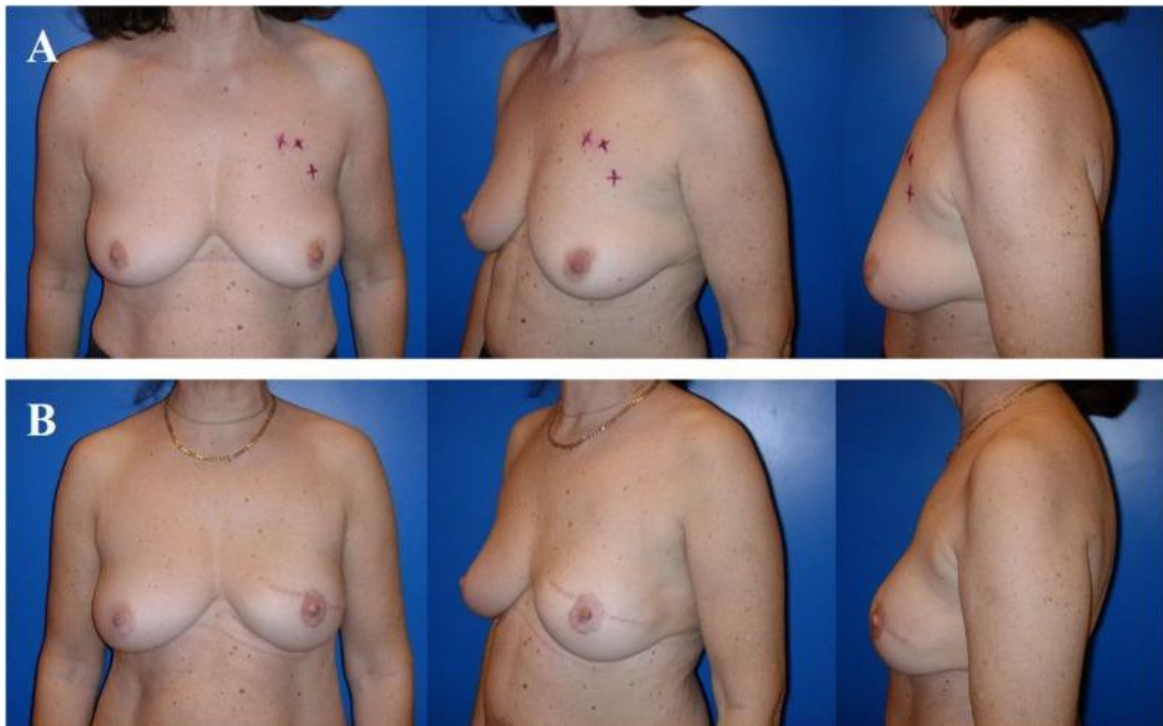


Figure 2: A 58-year-old patient before skin-sparing mastectomy for multifocal cancer of the left breast (A). 4 years after primary reconstruction of the left breast utilizing an implant in a subpectoral aircraft to cover the upper half of the implant and a resorbable mesh to prevent cranialization of the partly detached pectoralis major muscle, in addition to reconstruction of the nipple-- areolar complex (star flap for the nipple and tattoo of the nipple and neo-areola). Keep in mind the nearly symmetric size and contour of both breasts (B). ⁽¹⁰⁾

Implant-based breast restorations prone to establish implant-related local complications throughout the subsequent 10 years with a risk for a reoperation of 70%⁽²⁴⁾. Around 25 and 35% of the patients are being identified with severe capsular contracture and, respectively, implant rupture⁽²⁵⁾. This high issue rate results from the thin skin envelope staying after mastectomy, which does not provide any robust protection of the implant. This problem rate does neither consider breast shape deformity and asymmetry in the context of mild to moderate capsular contracture nor does it think about an even worse outcome in implant-based breast reconstruction with irradiated skin. De facto, breast reconstruction using implants might yield very great long-term results that are enough lots of patients, yet the implant will always remain more or less fixed to the thoracic wall and subsequently the breast maintains a special shape, separately from the patient's posture. Implant-based breast reconstruction will not allow recreating a naturally shaped photic breast in most patients, and therefore often requires adaptive surgical treatment of the contralateral breast to accomplish balance^(26,27). Though, implant-based breast reconstruction avoids from "civilian casualties," such as scars, contour defect, and muscular weak point, as it might be seen after flap harvesting for flap-based breast reconstruction⁽¹⁰⁾.

Breast Reconstruction with Autologous Fat Graft-Based

Autologous fat grafting (AFG; lipografting, lipofilling) explains the harvesting of the patient's fat using liposuction followed by its reinjection into the tissue to be remedied or enhanced. Fat grafting to the breast is more than 100 years of ages given that Holländer corrected a retracted scar after mastectomy by injecting parceled fat into the scar⁽²⁸⁾. AFG to the breast has ended up being a popular tool over the last 20 years, both in reconstructive and esthetic surgery. Concerning the breast, AFG has shown to be particularly effective to correct post-surgical abnormalities, such as contour defects and volume asymmetries after BCT, "rippling" after implant-based reconstruction and enhancement of the shift zone between flap and skin in the neckline^(29,30), in addition to the preparation of the postmastectomy irradiated chest wall prior to implant positioning⁽³¹⁾. In selected cases, de novo reconstruction of the breast by means of AFG has revealed really appealing outcomes. The patient needs to have numerous donor sites geared up with fat, due to the fact that the reconstructive procedure normally takes 4 to 6 stages of fat grafting, each separated by 3 months at least⁽³²⁾. Irradiated skin does practically preclude this technique, considering that injected fat is not engrafted as wanted⁽³³⁾.

Autologous fat grafting is a "natural" filler, and unlike synthetic fillers will neither induce any foreign body reaction nor be resorbed completely. Today, harvesting of the fat is gone over, to name a few, with regard to structure of the infiltration solution, to diameter and shape of the gathering cannula and to suction forces. In order to be structural, injection of the fat must be performed in small aliquots using blunt cannulas in numerous directions and numerous layers. This multi-planar technique optimizes the fat-to-tissue contact, thus the exposition of non-vascularized fat to vascularized host tissue⁽³⁴⁾. Consensus exists on the fact that fat might not be injected into the glandular tissue of the breast. Commonly, 60-- 70% of the injected fat is engrafted to the host tissue. Fat necrosis and oil cysts prevail problems after AFG and happen in ~ 5%⁽³⁵⁾. Necrosis of the implanted fat might likewise be associated with microcalcifications, which sometimes may be hard to identify from deadly breast cancer-associated microcalcifications⁽³⁶⁾. Presumably, the radiologist is a specialist, fat grafting-induced microcalcifications do no effect on the radiological follow-up⁽³⁷⁾. This fact might agitate the patient who has to appear for regular follow-up imaging and eventually go through diagnostic biopsy to leave out malignancy.

Presently, fat grafting to the breast is controversially talked about, particularly in the presence of staying glandular breast tissue, as, for example, after breast conserving therapy (BCT). Grafted fat that naturally includes progenitor and stem cells has actually recently been related to breast cancer development and metastasic spread in an experimental setting⁽³⁸⁾. Regardless of the absence of prospective follow-up research studies, fat implanting to rebuild or to refine a breast after mastectomy and/or after breast reconstruction- BCT not consisted of is nowadays thought about safe^(39,40).

Comparing between previous two reconstruction options

Although breast reconstruction utilizing autologous flap tissue permits a resilient and natural result, flap harvest will cause a "collateral damage" at the flap's donor site, including potential surgery-related problems, scars, shape defect, and functional impairment. Microvascular flap-based breast reconstruction is not just technically more requiring, however likewise requires more infrastructures within a breast reconstruction unit, as compared to implant-based breast reconstruction (**Table 1**)⁽¹⁰⁾.

Table 1: Advantages and disadvantages of implant-based versus autologous tissue-based techniques of breast reconstruction. ⁽¹⁰⁾

	Implant-based breast reconstruction	Autologous tissue-based breast reconstruction
Duration of surgery (h)	1–2	4–6
Infrastructural effort	Low	High ^a
Surgical complexity	Low	High
Donor site	None	Depending on flap ^b (abdominal, thigh, gluteal, dorsal region)
Complication rate (30 days) (implant-, respectively, flap-related) (%)	2–4	2–4
Complication rate (long-term)	Higher (due to capsular contracture)	Lower
Long-term reoperation rate	More likely	Less likely
Patient satisfaction	Short-term	Long-term

^aMicroscope, specific instruments, trained personnel (nurses in OR). ^bDiscomfort, pain, scars, abdominal bulging, hernia, asymmetry, and contour deformity.

Reconstruction of the nipple:

A mastectomy that preserves a woman's own nipple and areola, called nipple-sparing mastectomy, may be a choice for some women, depending upon the size and location of the breast cancer and the sizes and shape of the breasts ^(41,42). The method of nipple sparing mastectomy (NMS) with immediate reconstruction is an oncologically safe treatment ^(43,44) and related to the best aesthetic results ⁽⁴⁵⁾ in case of therapeutic as well as of prophylactic mastectomies and if the postoperative course is uneventful. Autologous reconstruction by DIEP- or TRAM flap is connected with exceptional long time outcomes ⁽⁴⁵⁾, however there are numerous surgery-associated issues which can severely impair long period of time outcomes and oncologic outcome. The NSM technique is an extremely demanding procedure in respect of skin, so that there will be a portion in between 2 and 22 % of skin or nipple necrosis. The rate of perfusion issues differs by surgical skills, mastectomy cut type ⁽⁴⁵⁾ and patients risk factors such as regional factors like ptosis or breast hyperplasia with a need for mastopexy methods. On the other hand, systemic factors like weight problems, smoking cigarettes or diabetes add to regional problems.

4. CONCLUSION

Improvements in autologous flap strategies, improvements in prosthetic innovations and the advancement of novel tissue substitutes have actually allowed for ongoing improvements in breast reconstruction results. In the future we can likewise anticipate that lots of new alternatives and strategies will have a substantial impact on reconstructive breast surgical treatment, consisting of nipple sparing mastectomy, oncoplastic surgical treatment, brand-new biologic tissue matrices, various types of radiation treatment, neoadjuvant chemotherapy, long term hormone treatment, and the use of angiogenesis inhibitors. There is no ideal approach that can be embraced as the standard; rather, the choice should be individualized depending upon patient-related and oncological factors. Autologous tissue reconstruction may be chosen based upon relative permanency of its outcomes and elimination of reliance on an irreversible prosthesis; whereas a prosthetic reconstruction might be favored as a less intrusive treatment that is generally well endured. Regardless of the strategy picked, the primary objective of breast reconstruction is to improve patient satisfaction, self-image and expectations, while minimizing morbidity.

REFERENCES

- [1] Torre LA, Bray F, Siegel RL, Ferlay J, Lortet-Tieulent J, Jemal A. Global cancer statistics, 2012. *CA Cancer J Clin* (2015) 65(2):87–108.10.3322/caac.21262.

- [2] Sakorafas GH, Safioleas M. Breast cancer surgery: an historical narrative. Part II. 18th and 19th centuries. *Eur J Cancer Care (Engl)* (2010) 19(1):6–29.10.1111/j.1365-2354.2008.01060.x
- [3] Patey DH. A review of 146 cases of carcinoma of the breast operated on between 1930 and 1943. *Br J Cancer* (1967) 21(2):260–9.10.1038/bjc.1967.28
- [4] Fisher B, Bauer M, Margolese R, Poisson R, Pilch Y, Redmond C, et al. Five-year results of a randomized clinical trial comparing total mastectomy and segmental mastectomy with or without radiation in the treatment of breast cancer. *N Engl J Med* (1985) 312(11):665–73.10.1056/NEJM198503143121102.
- [5] Malhaire C, Hequet D, Falcou MC, Feron JG, Tardivon A, Leduey A, et al. Outcome of oncoplastic breast-conserving surgery following bracketing wire localization for large breast cancer. *Breast* (2015) 24(4):370–5.10.1016/j.breast.2015.02.037.
- [6] Veiga DF, Veiga-Filho J, Ribeiro LM, Archangelo I, Jr, Balbino PF, Caetano LV, et al. Quality-of-life and self-esteem outcomes after oncoplastic breast-conserving surgery. *Plast Reconstr Surg* (2010) 125(3):811–7.10.1097/PRS.0b013e3181ccdac5.
- [7] Shons AR, Moiseillo G. Post-mastectomy, breast reconstruction: current techniques. *Cancer control*, Sept/Oct. 8(5). 4. Techniques for breast reconstruction—University of Michigan /<http://www.med.umich.edu/surg/breast/recon/index.htm>S. 5. Pennington D. Breast reconstruction after mastectomy: current state of the art. *ANZ J Sur* 2005;75:454–8.
- [8] Pusic A, Thompson TA, Kerrigan CL, Sargeant R, Slezak S, Chang BW, et al. Surgical options for the early-stage breast cancer: factors associated with patient choice and postoperative quality of life. *Plast Reconstr Surg* 1999;104(5): 1325–33.
- [9] Pennington D. Breast reconstruction after mastectomy: current state of the art. *ANZ J Sur* 2005;75:454–8.
- [10] Blomqvist L, Malm M. Clinical experience with the lateral thoracodorsal flap in breast reconstruction. *Ann Plast Surg* 1999;43:7–13.
- [11] Brandberg Y, Malm M, Blomqvist L. A prospective and randomized study, “SVEA,” comparing effects of three methods for delayed breast reconstruction on quality of life, patient-defined problem areas of life, and cosmetic result. *Plast Reconstr Surg* 2000;105:66–74.
- [12] Al-Ghazal SK, Fallowfield L, Blamey RW. Comparison of psychological aspects and patient satisfaction following breast conserving surgery, simple mastectomy and breast reconstruction. *Eur J Cancer* 2000;36:1938–43.
- [13] Barton FE, Jr, English JM, Kingsley WB, Fietz M.. Glandular excision in total glandular mastectomy and modified radical mastectomy: a comparison. *Plast Reconstr Surg* (1991) 88(3):389–92; discussion 393–4.10.1097/00006534-199109000-00001
- [14] Schmauss D, Machens H-G, Harder Y. Breast Reconstruction after Mastectomy. *Frontiers in Surgery*. 2015;2:71. doi:10.3389/fsurg.2015.00071.
- [15] Singletary SE, Robb GL. Oncologic safety of skin-sparing mastectomy. *Ann Surg Oncol* (2003) 10(2):95–7.10.1245/ASO.2003.01.910
- [16] Simmons RM, Adamovich TL.. Skin-sparing mastectomy. *Surg Clin North Am* (2003) 83(4):885–99.10.1016/S0039-6109(03)00035-5.
- [17] Alborno CR, Bach PB, Mehrara BJ, Disa JJ, Pusic AL, McCarthy CM, et al. A paradigm shift in U.S. breast reconstruction: increasing implant rates. *Plast Reconstr Surg* (2013) 131(1):15–23.10.
- [18] Kwok AC, Goodwin IA, Ying J, Agarwal JP.. National trends and complication rates after bilateral mastectomy and immediate breast reconstruction from 2005 to 2012. *Am J Surg* (2015) 210(3):512–6.
- [19] Cronin T D, Gerow F J. Augmentation mammoplasty: a new “natural feel” prosthesis. Amsterdam: In: Transactions of the Third International Congress of Plastic and Reconstructive Surgery; Excerpta Medica; 1963.
- [20] Snyderman R K, Guthrie R H. Reconstruction of the female breast following radical mastectomy. *Plast Reconstr Surg*. 1971;47:565–567.

- [21] Birnbaum L, Olsen J A. Breast reconstruction following radical mastectomy, using custom designed implants. *Plast Reconstr Surg*. 1978;61:355–363.
- [22] Radovan C. Breast reconstruction after mastectomy using the temporary expander. *Plast Reconstr Surg*. 1982;69:195–208.
- [23] Becker H. Breast reconstruction using an inflatable breast implant with detachable reservoir. *Plast Reconstr Surg*. 1984;73:678–683.
- [24] Champaneria MC, Wong WW, Hill ME, Gupta SC.. The evolution of breast reconstruction: a historical perspective. *World J Surg* (2012) 36(4):730–42.10.1007/s00268-012-1450-2 [PubMed] [Cross Ref]
- [25] Cronin TD, Greenberg RL. Our experiences with the silastic gel breast prosthesis. *Plast Reconstr Surg* (1970) 46(1):1–7.
- [26] Cronin TD, Upton J, McDonough JM. Reconstruction of the breast after mastectomy. *Plast Reconstr Surg* (1977) 59(1):1–14.
- [27] Gabriel SE, Woods JE, O’Fallon WM, Beard CM, Kurland LT, Melton LJ., III. Complications leading to surgery after breast implantation. *N Engl J Med* (1997) 336(10):677–82.
- [28] Holländer. Die kosmetische Chirurgie. In: Joseph M, editor. , editor. *Handbuch der Kosmetik*. Leipzig: Veit & Comp; (1912). p. 669–712; 673.
- [29] Delay E, Gosset J, Toussoun G, Delaporte T, Delbaere M.. [Efficacy of lipomodelling for the management of sequelae of breast cancer conservative treatment]. *Ann Chir Plast Esthet* (2008) 53(2):153–68.10.1016/j.anplas.2007.09.005
- [30] Kanchwala SK, Glatt BS, Conant EF, Bucky LP.. Autologous fat grafting to the reconstructed breast: the management of acquired contour deformities. *Plast Reconstr Surg* (2009) 124(2):409–18.10.1097/PRS.0b013e3181aeadd
- [31] Sarfati I, Ihrai T, Duvernay A, Nos C, Clough K.. [Autologous fat grafting to the postmastectomy irradiated chest wall prior to breast implant reconstruction: a series of 68 patients]. *Ann Chir Plast Esthet* (2013) 58(1):35–40.10.1016/j.anplas.2012.10.007
- [32] Hoppe DL, Ueberreiter K, Surlemont Y, Peltoniemi H, Stabile M, Kauhanen S. Breast reconstruction de novo by water-jet assisted autologous fat grafting – a retrospective study. *Ger Med Sci* (2013) 12(11):Doc17.10.3205/000185
- [33] Longo B, Laporta R, Sorotos M, Pagnoni M, Gentilucci M, Santanelli di Pompeo F.. Total breast reconstruction using autologous fat grafting following nipple-sparing mastectomy in irradiated and non-irradiated patients. *Aesthetic Plast Surg* (2014) 38(6):1101–8.
- [34] Coleman SR.. Structural fat grafting: more than a permanent filler. *Plast Reconstr Surg* (2006) 118(3 Suppl):108S–20S.1
- [35] Kaoutzanis C, Xin M, Ballard TN, Welch KB, Momoh AO, Kozlow JH, et al. Autologous fat grafting after breast reconstruction in postmastectomy patients: complications, biopsy rates, and locoregional cancer recurrence rates. *Ann Plast Surg* (2015).
- [36] Rubin JP, Coon D, Zuley M, Toy J, Asano Y, Kurita M, et al. Mammographic changes after fat transfer to the breast compared with changes after breast reduction: a blinded study. *Plast Reconstr Surg* (2012) 129(5):1029–38.
- [37] Gosset J, Guerin N, Toussoun G, Delaporte T, Delay E.. [Radiological evaluation after lipomodelling for correction of breast conservative treatment sequelae]. *Ann Chir Plast Esthet* (2008) 53(2):178–89.
- [38] Schweizer R, Tsuji W, Gorantla VS, Marra KG, Rubin JP, Plock JA.. The role of adipose-derived stem cells in breast cancer progression and metastasis. *Stem Cells Int* (2015) 2015:120949.
- [39] Lohsiriwat V, Curigliano G, Rietjens M, Goldhirsch A, Petit JY. Autologous fat transplantation in patients with breast cancer: “silencing” or “fueling” cancer recurrence? *Breast* (2011) 20(4):351–7.

- [40] Claro F, Jr, Figueiredo JC, Zampar AG, Pinto-Neto AM.. Applicability and safety of autologous fat for reconstruction of the breast. *Br J Surg* (2012) 99(6):768–80.
- [41] Petit JY, Veronesi U, Lohsiriwat V, et al. Nipple-sparing mastectomy—is it worth the risk? *Nature Reviews Clinical Oncology* 2011; 8(12):742–747.
- [42] Gupta A, Borgen PI. Total skin sparing (nipple sparing) mastectomy: what is the evidence? *Surgical Oncology Clinics of North America* 2010; 19(3):555–566.
- [43] Wang F, Peled AW, Garwood E, Fiscalini AS, Sbitany H, Foster RD, Alvarado M, Ewing C, Hwang ES, Esserman LJ. Total skin-sparing mastectomy and immediate breast reconstruction: an evolution of technique and assessment of outcomes. *Ann Surg Oncol.* 2014;21(10):3223–30.
- [44] Zinzindohoué C, Bertrand P, Michel A, Monrigal E, Miramand B, Sterckers N, Faure C, Charitansky H, Gutowski M, Cohen M, Houvenaeghel G, Trentini F, Raro P, Daures JP, Lacombe S. A prospective study on skin-sparing mastectomy for immediate breast reconstruction with latissimus dorsi flap after neoadjuvant chemotherapy and radiotherapy in invasive breast carcinoma. *Ann Surg Oncol.* 2016;23(7):2350–6.
- [45] Sakurai T, Zhang N, Suzuma T, Umemura T, Yoshimura G, Sakurai T, Yang Q. Long-term follow-up of nipple-sparing mastectomy without radiotherapy: a single center study at a Japanese institution. *Med Oncol.* 2013;30(1):481.