




Advocating for closer collaboration in breast surgery and breast reconstruction: a narrative review

Shanshan He^{1,2,3,4,5}, Jian Yin^{1,2,3,4,5} 

¹Department of Breast Reconstruction, Tianjin Medical University Cancer Institute and Hospital, Tianjin, China; ²National Clinical Research Center for Cancer, Tianjin, China; ³Key Laboratory of Cancer Prevention and Therapy, Tianjin, China; ⁴Key Laboratory of Breast Cancer Prevention and Therapy, Tianjin Medical University, Ministry of Education, Tianjin, China; ⁵Tianjin's Clinical Research Center for Cancer, Sino-Russian Joint Research Center for Oncoplastic Breast Surgery, Tianjin, China

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Correspondence to: Jian Yin. Huanhu Xi Road, Hexi District, Tianjin 300060, China. Email: yinjian@tjmuch.com.

Abstract: In the surgical treatment for breast cancer patients, preference for breast conservation and oncoplastic breast reconstruction is increasing across the world. This current treatment modality demands a holistic understanding of breast cancer treatment and oncoplastic procedures and requires comprehensive surgical skills. China has the world's largest population which has specific characteristics and relies on a medical care system that is different from most Western countries. Studies on this specific population can provide valuable information in guiding clinical practices for physicians. A MEDLINE (PubMed) search using a combination of keywords, “breast reconstruction”, “breast surgery”, “breast cancer”, and “China” or “Chinese”, from January 2001 to April 2020 yielded 40 clinical studies on the mainland Chinese population and a trend towards increased publication in the past 5 years. Due to the multifaceted nature of breast reconstruction post breast surgery and a paucity of clinical studies concerning the aspect of oncological resection in Chinese patients, the authors aimed to write this narrative review from an oncological perspective (including incision design, mastectomy flap perfusion, preservation of collateral vessels, timing of radiation and reconstruction, reconstruction plane). It is hoped this discussion can facilitate the collaboration between surgeons of different specialties and improve surgical outcomes. Establishment of oncoplastic teams is strongly advocated in Chinese medical centers to maximize the quality of multidisciplinary care to breast cancer patients.

Keywords: Breast surgery; breast reconstruction; multidisciplinary collaboration

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Introduction

The modern age has seen a global rise in oncoplastic breast-conserving surgery for breast cancer patients. For those patients who are not candidates for breast conservation, post-mastectomy breast reconstruction has become

increasingly prominent compared to mastectomy alone (1,2). A study conducted in 2017 in China by the China Anti-Cancer Association and the Chinese College of Surgeons revealed that of the 110 surveyed institutional hospitals, 87.3% had performed breast reconstructions (3). In 2017,

[^] ORCID: 0000-0001-6735-2834.

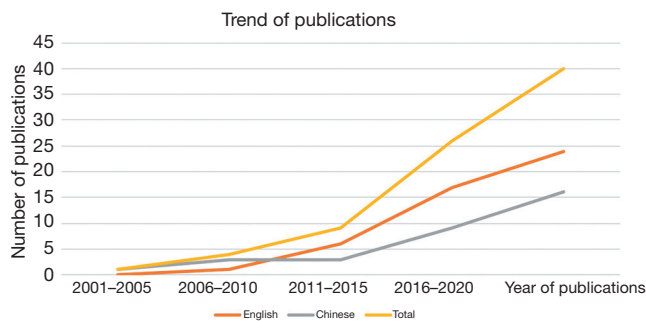


Figure 1 Publication trends in the clinical research on mainland Chinese patients from January 2001 to April 2020.

10.7% of the post-mastectomy patients received breast reconstruction, 67.6% of which were immediate, and 65% of which were implant-based reconstructions.

According to the same survey, approximately 40% of the total breast conserving cases were oncoplastic, and 15% of the oncoplastic cases were partial breast reconstructions (4). Given that breast conservation and oncoplastic reconstruction are being increasingly favored in China, there is a higher demand for physicians to have expertise in breast cancer treatment, breast oncoplasty, and breast reconstruction. Consequently, a closer multidisciplinary collaboration among different specialties is critical to providing optimal care for patients. From the oncological perspectives, we summarized the primary issues that could promote better collaboration and improve surgical outcomes. We present the following article in accordance with the Narrative Review reporting checklist (available at <http://dx.doi.org/10.21037/abs-20-64>).

Methods

A MEDLINE (PubMed) search for articles published between January 2001 and April 2020 was performed using a combination of the following keywords: “breast reconstruction”, “breast surgery”, “breast cancer”, and “China” or “Chinese”. Articles were limited to English or Chinese language. Titles, abstracts, and full texts, if available, were scrutinized by the two authors of this review. Studies pertaining to the clinical research on breast reconstruction in the Chinese population in mainland China were included. Review articles, clinical research studies on non-mainland Chinese databases/populations, and benchwork studies were excluded. Relevant studies were classified as trend studies, surgical technique-related, or diagnostic/adjuvant therapy-related. Studies with more

than 6 months of follow-up were noted as reporting long-term outcomes.

Results

There were a total of 60 potential citations from the MEDLINE search, and 40 clinical studies with data collected on patients from mainland China were reviewed. The number of publications in both the English and Chinese languages has nearly tripled over the past 5 years (*Figure 1*). Of the 40 studies, 11 were trend/survey analyses on breast reconstruction, 9 were related to reconstructive surgical techniques, 5 were related to diagnostic measures or adjuvant treatment, and 25 reported long-term aesthetic, oncological, or quality of life outcomes.

Discussion

Incision design

The art of surgical planning and execution comprise both oncological and plastic considerations, and poses challenges to surgeons. For the benefits of postoperative aesthetics, nipple-sparing mastectomy (NSM)/skin-sparing mastectomy (SSM) have been shown to be superior and are the preferred options for many breast surgeons. Given the demonstrated oncologic safety of both NSM and SSM, breast surgeons frequently design incisions in locations that are well concealed but that also allow sufficient access and exposure to perform the mastectomy.

An adequate incision design facilitates proper mastectomy and preserves maximal flap perfusion. An additional axillary incision can be performed if an axillary dissection is needed to minimize traumatic traction on the mastectomy skin flaps. A wide variety of incisions have been described, including peri-areolar, circum-areolar, lateral, inframammary fold, radial, mastopexy/reduction, and endoscopic incisions, and there is no consensus as to the best choice. A recent systematic review on NSM incisions for patients undergoing immediate reconstruction revealed a shift towards the inframammary (37.8%) incision followed by radial (37.2%), and peri-areolar incisions (15.2%) (5). Although offering easy access for the mastectomy along with well-hidden scars, a pooled rate analysis showed peri-areolar incisions had the highest risk for nipple-areolar complex (NAC) necrosis, reaching an incidence of nearly 20% (5), posing the subsequent reconstruction at higher risk. To combat this, peri-areolar combined with

radial incisions have often been used in our practice for patients with an NAC diameter smaller than 3.5 cm, with intraoperative indocyanine green (ICG) imaging of the NAC and the mastectomy flap being routinely used to assess adequate perfusion. Reduction incisions have been found to be the preferred choices for oncoplastic breast-conserving surgery and in circumstances when breast conservation is performed in a pendulous, ptotic breast. Skin-reducing techniques that preserve the NAC and sufficient breast skin are our preferred choices for oncoplastic reconstruction (6-8).

Mastectomy flap perfusion

Maintaining adequate mastectomy flap perfusion can reduce the risk of flap necrosis that leads to reconstructive failure and the potential delay of adjuvant therapies. Previous studies have used preoperative magnetic resonance imaging (MRI) to evaluate mastectomy skin flap thickness and observed that a NSM flap thickness smaller than 8 mm increased the risk of ischemic events (9). However, a thicker mastectomy flap may contain residual breast tissue that can increase the risk of local recurrence. A flap thicker than 5 mm was found to significantly increase the prevalence of residual breast tissue (10). Other studies have found skin flaps used during a NSM and prophylactic mastectomy are associated with the presence of residual breast tissue (11). Again, a delicate balance exists between performing a sound oncologic mastectomy and minimizing ischemic injury to the skin flaps that can compromise the final aesthetic result.

Anatomical studies of the breast have revealed a superficial fascial system encasing the corpus mammae, with the Cooper's ligament going through the fascial system, connecting the deep fascia and the dermis (12). Beer *et al.* reported that no breast tissue is present superficial to the superficial fascial layer; however, not all breasts possess a superficial fascial layer, and the distance between the dermis and this layer can vary between 0.2 and 4 mm (13). Larson *et al.*, on the other hand, found that the subcutaneous tissue between the dermis and the breast parenchyma had a median thickness of 10 mm; however, no correlations were found between the thickness of the subcutaneous tissue and body mass index, age, breast specimen weight, or the subcutaneous thickness of the contralateral breast (14). The discrepancies between these studies could be attributed to the different quadrants of the mastopexy sampling. From the authors' experience in Chinese patients, there is tremendous variability of subcutaneous thickness between individuals or from one breast to the other. In our practice

of immediate reconstruction for breast cancer patients, we routinely keep a thin mastectomy flap (*Figure 2*), and we feel a 1 cm median mastectomy flap thickness should be managed with caution. It is possible that ethnic differences exist across Asian and Western populations in terms of subcutaneous tissue thickness; however, more studies are necessary to determine an ideal flap thickness to suit the Chinese population.

Preservation of collateral vessels

Post-mastectomy lymphedema can adversely affect patients' arm function and quality of life. Studies have shown that patients who undergo axillary lymph node dissection have four times the risk of developing lymphedema than those who have sentinel lymph node biopsy (15). Recently, super-microsurgical repair of the lymphatic system has become increasingly prevalent and is now considered the standard treatment at many institutions, with excellent outcomes reported in long-term follow-ups (16,17). Several studies have reported prophylactic surgery performed concurrently with an axillary lymph node dissection can also reduce the risk of secondary lymphedema (18-20) with a median reduced life-time cost of approximately 45% for the healthcare system (21). ICG fluorescent imaging or blue dye (18,22) is used to trace lymphatic vessels using reverse axillary mapping, and end-to-end, end-to-side, or octopus anastomoses can be performed to restore drainage through the axilla. The orientation of the anastomoses are based on the number, size, and pressure of the lymphatic and recipient veins (22-25). Most authors report use of collateral branches of the axillary vessels such as the lateral thoracic vessels or branches of the thoracodorsal vessels as recipients for lymphovenous bypass or for vascularized free lymph node transfer. Preservation of these vessels at the time of axillary lymph node dissection by breast surgeons could facilitate the subsequent anastomosis.

Timing of reconstruction and radiation

Radiation is an essential therapy in the comprehensive treatment for breast cancer and can significantly reduce local recurrence and improve overall survival (26). However, radiation can lead to inflammation and fibrotic changes to the tissue and have adverse effects on the reconstructed breast (26,27). The timing and the type of breast reconstruction are important considerations for resection and reconstructive surgery when post-operative radiation is

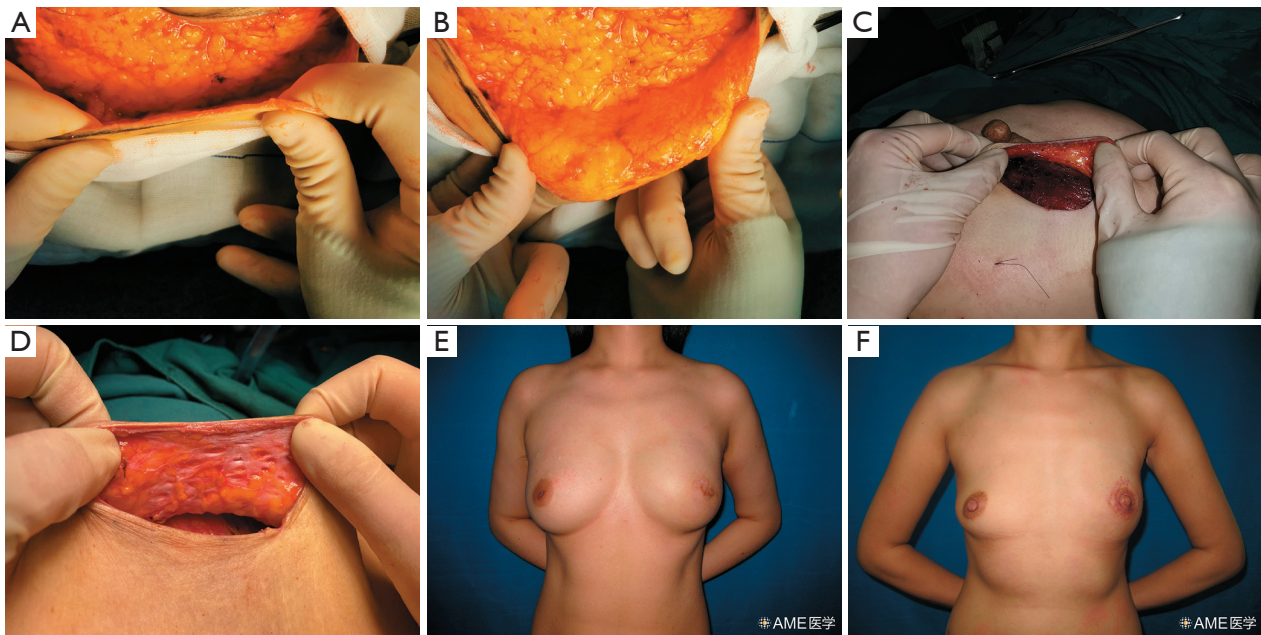


Figure 2 Mastectomy flap thickness in modified radical mastectomy (A,B). Modified radical mastectomy followed by immediate implant reconstruction combined with acellular bovine pericardium (C) and latissimus dorsi flap (D). Twelve months' follow-up post left NSM and immediate implant reconstruction combined with acellular bovine pericardium (E). Fourteen months' follow-up post left SSM and immediate reconstruction with extended latissimus dorsi (F). All surgeries were performed by the senior surgeon Dr. JY. NSM, nipple-sparing mastectomy; SSM, skin-sparing mastectomy.

indicated.

Autologous reconstruction is generally recommended and is considered the gold standard for breast reconstruction in patients receiving chest wall radiation, as implant-based reconstruction is fraught with higher morbidity and complications rates (28-31). Multiple studies have reported that the sequence of radiation and autologous reconstruction has no impact on the overall occurrence of complications (32-35), while other researchers have found that radiation poses higher risks for fat necrosis in autologous reconstruction (36-38). This is a serious issue that can cause anxiety for the patient and physician alike, eliciting the potential differential diagnosis for local recurrence during follow-ups. In addition, radiation can induce flap shrinkage leading to noticeable asymmetry, and in severe cases it may require further surgical interventions (38,39).

Radiation has been shown to increase grade III-IV capsular contracture to 32% and reconstruction failure to 20% in prosthesis device-based reconstruction (40-42). Two-staged prosthesis-based reconstruction is widely employed in most medical centers internationally. The exchange from tissue expander (TE) to permanent implant (PI) can be performed

before or after radiation. There is a general consensus that radiation on TE increases the risk for prosthesis loss compared with radiation on PI (22.9% *vs.* 5.6%) (43). On the other hand, radiation on the PI can increase the risk for capsular contracture, compared with radiation on TE. However, the lower risk of capsular contracture using a two-stage approach may be due to the opportunity to perform capsulotomies and capsulectomy at the time of exchange after radiation. Direct-to-implant (DTI) reconstructions with a pedicled latissimus dorsi flap or bio-prosthetic meshes have drawn increasing attention, but have produced similar complications and outcomes compared with two-staged TE/PI reconstruction (44-46). In our cancer center, the majority of the implant-based reconstructions are DTI, as it can obviate the need for expansion and a secondary operation for exchanging the expander for a PI. Other factors such as insurance coverage and access to prosthetic materials are also factors that we consider in our algorithmic approach to reconstruction. In general, the authors also favor the use of textured anatomic silicone implants compared to smooth round implants. Several studies have compared the impact of post-mastectomy

radiation on DTI reconstruction and two-staged TE/PI reconstruction and concluded that radiation poses a higher risk for complications in TE/PI reconstruction than in DTI reconstruction (47-49). We advocate durable, viable coverage of the implant to reduce the risk of reconstructive failure in patients requiring postoperative radiation. Again, a balance in performing a complete mastectomy that leaves no residual breast tissue while maintaining viable perfusion of the mastectomy skin flap is critical to achieving this objective. More studies are necessary to delineate the suitable population for DTI, especially in setting the level of radiation.

Plane of prosthesis insertion

With the advances of NSM/SSM and the advent of prosthesis and biomaterials, prepectoral breast reconstruction is gaining popularity, as it is able to maintain the reconstructed breast in the original anatomical space. In either the total or partial subpectoral technique, insertion of the prosthesis requires the elevation of muscle, which can lead to animation deformity, muscle spasm, and pain (50-54). Early prepectoral implant placement directly underneath the mastectomy flap is fraught with higher complications due to inadequate soft-tissue coverage. The application of acellular dermal matrix can provide a layer of soft tissue support and yield a higher success rate.

Numerous retrospective articles have compared the complications, oncological safety, quality of life, and pain score between prepectoral and subpectoral prosthetic breast reconstruction. While not increasing the risk for local recurrence (55), the most common complications in prepectoral prosthesis reconstruction are rippling, followed by seroma and skin flap necrosis (56). Some meta-analyses have shown that prepectoral prosthesis placement significantly reduces the odds of capsular contracture by half when compared with subpectoral placement (56,57). In the setting of pre- or postoperative radiation, the odds are further reduced to one-fourth (58). Other meta-analyses have revealed similar results related to implant loss, but results concerning the risk of skin flap necrosis are more controversial (54,56,58). The authors suggest careful patient selection and utilizing ICG imaging to ensure adequate mastectomy flap perfusion, especially in the pre-pectoral setting, to minimize the occurrence of post-operative complications. Further prospective studies of large cohorts on the Chinese population will provide more evidence to aid surgeons in proper patient selection and decision-making.

Establishment of oncoplastic teams

Surgical planning and treatment for breast cancer patients are best performed with multidisciplinary collaboration involving oncologists, plastic surgeons, radiologists, and radiation oncologists. The current treatment modality demands more refined and holistic surgical skills. In countries such as the United States and Canada, the oncological procedure is performed by surgical oncologists, and the subsequent reconstruction is performed by plastic surgeons (59,60). This approach ensures that the surgery is performed by experts in the respective fields; however, it requires coordination of physicians and access to medical services. Consequently, a surgery team with low volume and limited experience may see a higher frequency of complications, such as mastectomy skin necrosis and infection (61). A different approach combines oncological and plastic training, allowing one surgeon to complete the resection and reconstruction. Although it is more time-consuming and demands more resources, this single oncoplastic modality is gaining more popularity across the globe (62,63).

A survey conducted in 2017 in China reported that 77.8% of the hospitals containing both breast surgery and plastic surgery departments made collaborative efforts on breast surgery and reconstruction (3). Despite the high prevalence of this model, since 2012, an increasing number of hospitals have established breast oncoplastic departments, recruiting physicians who have both oncologic and plastic reconstructive surgical training. This new modality has proven to be more efficient and has helped increase the awareness of breast reconstruction in Chinese patients and the rate of immediate reconstruction in this population.

Conclusions

The treatment of breast surgery and restoration of breast aesthetics for breast cancer patients is a combination of art and science demanding careful preoperative planning, meticulous technique, and refined surgical skills. A holistic understanding of the breast cancer treatment and oncoplastic procedures ensures successful and reproducible treatment outcomes and reduces complications. While resection and reconstruction can be performed by separate independent services, a dual-trained oncoplastic reconstructive surgeon can also achieve excellent results. Regardless of which model is adopted, the establishment of oncoplastic teams is urgently needed in Chinese medical

centers to provide high quality multidisciplinary care to breast cancer patients.

While this narrative overview has hopefully provided an illuminating perspective, it may be limited by the unsystematic nature of its design, and more qualitative and quantitative systematic reviews of high-level clinical studies specific to the Chinese population are warranted.

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