Review Article

Breast reconstruction at the MD Anderson Cancer Center

Peirong Yu

Department of Plastic Surgery, The University of Texas, MD Anderson Cancer Center, Houston, TX, USA

Correspondence to: Peirong Yu, MD. Department of Plastic Surgery, The University of Texas, MD Anderson Cancer Center, Houston, TX, USA. Email: ronyumd@gmail.com.

Abstract: The introduction of the transverse rectus abdominis myocutaneous flap in the 1970s marks the beginning of modern breast reconstruction although implants were available even earlier mainly for breast augmentation. Mastectomy techniques have evolved from the early Halsted radical mastectomy to the modern skin sparing mastectomy. The latter made possible using implants for breast reconstruction. Although prosthetic reconstruction provides a simpler procedure with quick recovery, autologous reconstruction offers more natural and long-lasting results especially in the setting of radiotherapy. Both forms have been extensively used at the MD Anderson Cancer Center (MDACC) while microsurgical breast reconstruction has been the hallmark of the MDACC experience. One of the most challenging areas of breast reconstruction is how to achieve good results without compromising adjuvant therapy when post-mastectomy radiotherapy is required. Managing upper extremity lymphedema following breast cancer treatment is another difficult issue which has gained great attention in recent years. This article highlights the important work in various aspects of breast reconstruction that has been done at the MDACC.

Keywords: Breast reconstruction; deep inferior epigastric perforator flap (DIEP flap); post-mastectomy radiotherapy; delayed-immediate breast reconstruction; lymphedema

Submitted Apr 23, 2016. Accepted for publication May 09, 2016.
doi: 10.21037/gs.2016.05.03
View this article at: http://dx.doi.org/10.21037/gs.2016.05.03

Introduction

Breast reconstruction at the University of Texas, MD Anderson Cancer Center (MDACC) started in the early 1980s. The Department of Plastic Surgery was established in 1988, initially with only two plastic surgeons. Dr. Stephen S. Kroll was a notable pioneer in breast reconstruction. The department has grown tremendously since then (*Figure 1*).

MD Anderson's Nellie B. Connally Breast Center is one of the largest breast cancer centers in the United States, treating 40,000 patients a year. The number of breast reconstruction cases has increased significantly over the years (*Figure 2*). All types of breast reconstructions are performed including autologous tissue and prosthetic reconstructions, delayed and immediate reconstructions, pedicled flaps and free tissue transfers. The number of free flaps for breast reconstruction had a steady increase until recently when the use of prosthesis has increased (*Figure 3*). This is a nationwide trend due to a number of factors such as patient choices (early return to work etc.) and decreased reimbursement for free flap reconstructions. The type of pedicled flaps has also changed significantly (*Figure 4*). Initially the pedicled transverse rectus abdominis musculocutaneous (TRAM) flap was popular for pedicled flap reconstruction. This was largely replaced by free TRAM or DIEP flaps. The pedicled latissimus dorsi myocutaneous flap became popular in combination with a prosthesis. The latissimus dorsi flap alone, however, is usually inadequate to create a sizable breast.

Over the years, the faculty of Plastic Surgery at MDACC has contributed hundreds of high quality publications on breast reconstruction and addressed numerous issues surrounding breast reconstruction. Their experience and research helped shaping up breast reconstruction in the 1980s and 1990s. New advances in breast reconstruction and radiation as well as the surgical management of lymphedema also made significant contributions in this field.

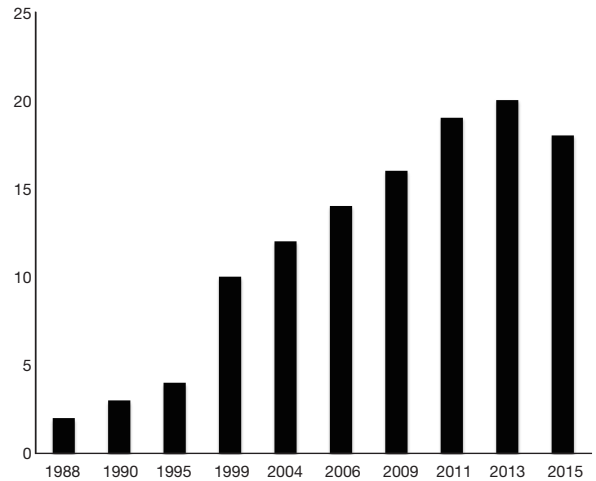

Figure 1 Number of faculties in the Department of Plastic Surgery at the MD Anderson Cancer Center (MDACC).

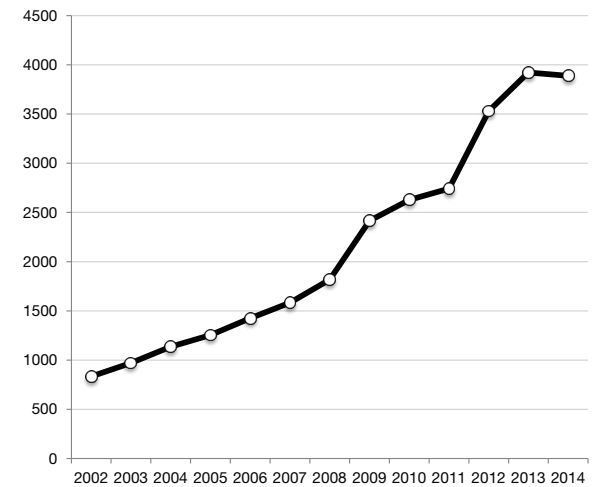

Figure 2 Total number of breast reconstructive cases.

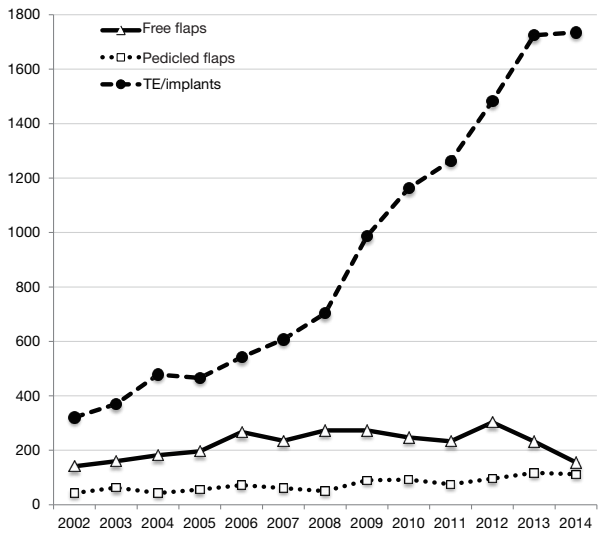

Figure 3 Types of breast reconstruction.

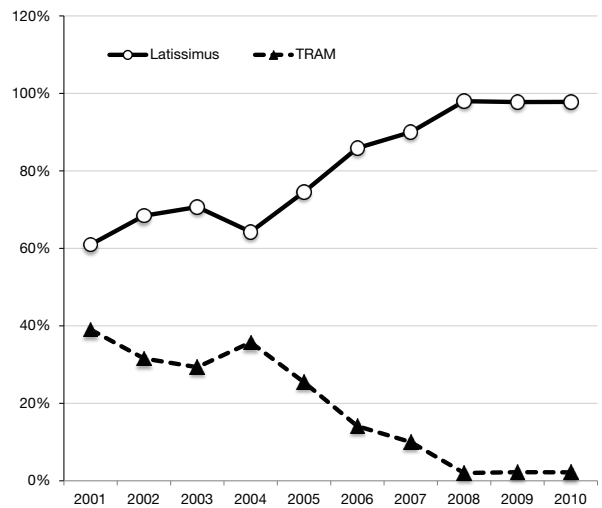

Figure 4 Types of pedicled flaps for breast reconstruction.

Delayed versus immediate reconstruction

In the early years, breast reconstruction was usually performed in a delayed fashion. The reasons were the limited awareness and resource availability for breast reconstruction and the concerns for oncologic safety. Further experience and studies showed that immediate reconstruction was oncologically safe (1,2). In addition, immediate reconstruction clearly yields superior cosmetic results and psychosocial benefits, and gradually gained popularity in the 1990s. With skin sparing mastectomy, the breast envelop is well preserved. Immediate reconstruction, therefore, can yield near normal appearance of the reconstructed breast. The relative contraindication for immediate breast reconstruction is the need for postmastectomy radiotherapy.

Evolution of mastectomy techniques

Mastectomy techniques have evolved from a Halsted "tissue-eradicating" to a modern "tissue-sparing" philosophy, from radical mastectomy, modified radical mastectomy, to skin-sparing mastectomy and nipple-sparing mastectomy (NSM). Numerous studies from MDACC and others have confirmed the oncologic safety of the

conservative approaches (1,3-5). Skin- and nipple-sparing mastectomies preserve the breast envelop, reduce scar formation, and significantly improve the aesthetic outcomes of breast reconstruction. Skin-sparing mastectomy is the current standard mastectomy procedure. However, removing the nipple-areola complex still causes significant dissatisfaction and psychosocial impact in patients. This led clinicians to explore the technical and oncologic feasibility of nipple-sparing mastectomy (NSM). For oncologic safety, it is generally accepted that the indications for NSM include: (I) tumor size <3 cm; (II) tumor located >2 cm from the nipple; (III) there is no skin involvement of tumor; (IV) negative axillary nodes on clinical examination; and (V) negative margins beneath nipple. Relative contraindications for NSM include smoking history, diabetes, hypertension, larger breast size, significant ptosis, and history of radiotherapy. All these are significant risk factors for nipple areola complex necrosis. The benefit of NSM is only evident when immediate breast reconstruction is performed. If immediate reconstruction is not performed, the breast skin envelop contracts once healed to the chest wall. Re-elevation of the skin envelop and nipple-areola complex can never obtain adequate volume and the nipple will end up in the upper portion of the breast. During delayed reconstruction, the nipple-areola complex and most of the breast skin will need to be removed and replaced with autologous tissue, thus defeating the purpose of NSM.

Autologous versus prosthetic reconstruction

Autologous and prosthetic reconstruction each has its own advantages and disadvantages. The main advantages of autologous reconstruction are that it is the patient's own tissue, looks and feels more natural, ages gracefully, tolerates radiation better, and it is permanent. The main disadvantage is the complexity, lengthy surgery, and long recovery. Prosthetic reconstruction is quite the opposite. It is quick and simple, fast recovery, but looks and feels less natural, may develop capsular contracture and rupture that require replacement, does not tolerate radiation, and it is not permanent. The average life of a breast implant is 10 years. For these reasons, plastic surgeons at MD Anderson have long been advocates for autologous reconstruction. In recent years, however, driven by patients, economics, and national trends, implant based reconstruction has also become popular at our institution (*Figure 3*). Kroll *et al*. found that although the initial cost for TRAM flap reconstruction was higher, the cost advantage of implant-based reconstruction disappeared over time due to complications and the need for subsequent surgeries (6).

Implants for breast reconstruction were first developed by Cronin and Gerow in 1962—the Dow Corning Corporation. These silicone gel implants underwent several refinements and the 3rd and 4th generation silicone implants in the 1980s had elastomer-coated shells to decrease leakage and offered textured surface and anatomic models. However, during the 1990s, thousands of women claimed sickness from their breast implants. The medical complaints included neurological and rheumatological health problems. Silicone implants were banned in the US in 1990. The Dow Corning Corporation went bankrupt in 1995 when it faced 19,000 breast implant sickness lawsuits. After 10 years of research and investigation, the Institute of Medicine published the Safety of Silicone Breast Implants study in 1999 which reported no evidence that saline filled and silicone-gel filled breast implant devices caused systemic health problems and that their use posed no new health or safety risks. On November 17, 2006, the US Food and Drug Administration lifted its restrictions against using silicone-gel breast implants for breast reconstruction and for augmentation mammoplasty. Long before the Institute of Medicine study, the MD Anderson plastic surgery group published a report in 1993 in which they prospectively studied patients who underwent breast reconstruction between 1986 and 1992 and found that the incidence of autoimmune disease in mastectomy patients receiving silicone gel implants was not different from those who had reconstruction with autologous tissue (7). They also found, in a cadaveric study, that silicon levels at distant tissue were no different between those with silicone gel implants and those without; and that there was no correlation between intact or ruptured implants and symptoms of collagen-vascular disease (8).

Free versus pedicled TRAM flaps

Since the introduction of TRAM flap, pedicled TRAM flap dominated breast reconstruction in the early days. Although it does not require microsurgical techniques, frequent fat necrosis and partial flap loss with the pedicled TRAM flap were encountered in obese patients, smokers, diabetic patients as well as those with hypertension. Pedicled TRAM flap is based on the superior epigastric vessels whereas the main blood supply to the TRAM flap is based on the deep inferior epigastric vessels which are the vascular pedicle of the free TRAM flap. Schusterman *et al*., in 1992, found that

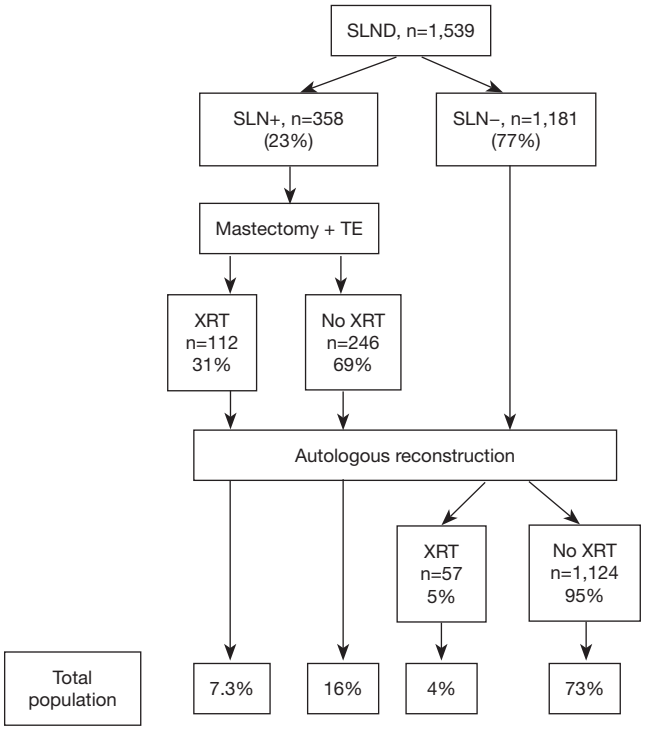

Figure 5 Sentinel node dissection before mastectomy.

the free TRAM flap resulted in much lower complications than the pedicled TRAM flap (9-11). Harvesting the rectus abdominis muscle inevitably causes abdominal weakness (12). In order to reduce the abdominal morbidity, Dr. Stephen Kroll and others pioneered the deep inferior epigastric perforator (DIEP) flap for breast reconstruction (13-15). With advances in perforator anatomy, various muscle-sparing TRAM flaps were then created. The superficial inferior epigastric artery (SIEA) flap has also been used for breast reconstruction but Dr. Pierre Chevray found that the SIEA was present or large enough in only 30–40% of the patients (16).

Breast reconstruction and radiation

Breast reconstruction in patients requiring postoperative radiotherapy can be a difficult clinical dilemma (17-25). Current indications for postoperative radiotherapy at MDACC include: (I) T3 or T4 tumor; (II) N2 fixed axillary lymph nodes or positive internal mammary nodes; (III) N3 nodal disease (infraclavicular, supraclavicular, internal mammary and axillar nodes); (IV) extranodal extension; (V) presence of 4 or more positive lymph nodes. However, there have been reports showing that postoperative radiotherapy may be beneficial in 1–3 positive lymph nodes or in T1, T2 tumors. This is still controversial. Postoperative radiotherapy can have significant effect on the reconstructed breast, including high incidences of fat necrosis, volume loss, and contracture. The effect on implant-based reconstruction is even worse, often leading to implant failure requiring removal and autologous reconstruction. Therefore, immediate breast reconstructions are not recommended at MDACC when postoperative radiotherapy is planned. There are occasions, however, patients may have clinically negative nodal status preoperatively and undergo breast reconstruction while permanent histology reveals positive lymph nodes that require postoperative radiotherapy. In a recent unpublished review of autologous breast reconstructions at MDACC, among 1,539 cases of sentinel lymph node dissections (SLND), 23% (n=358) were positive and underwent mastectomy with tissue expander. Among them, 31% (n=112) required postoperative radiotherapy and 69% did not. In the 77% (n=1,181) negative SLN who underwent autologous reconstruction, 57 patients required postoperative radiotherapy based on permanent pathologic findings (*Figure 5*). For this patient population in which postoperative radiotherapy is uncertain at the time of surgery, the concept of "delayed-immediate reconstruction" was introduced by Dr. Steve Kronowitz in 2004 to address this issue (17,22,23). In brief, a tissue expander is placed at the time of mastectomy with maximum possible initial saline fill. If postmastectomy radiotherapy is indicated based on permanent sections, the tissue expander is deflated to allow effective radiation delivery. The tissue expander is re-inflated after radiation therapy followed by definitive breast reconstruction with autologous tissue flaps with or without implants (*Figure 6*).

Recipient vessel selections have also undergone significant changes. The thoracodorsal vessels have been gradually replaced by the internal mammary vessels as recipient vessels for free flap breast reconstruction (26-28). The internal mammary vessels are closer to the defect, have sufficient calibers and flow, and easier for positioning during anastomosis. They are also less affected by radiation. In patients with narrow rib spaces, the 3rd costal cartilage is often removed for adequate exposure during recipient vessel dissection. With wide rib spaces, the internal mammary vessels can be safely dissected out without removing the rib cartilage. Some patients have large internal mammary perforators that can be used as recipient vessels without exposing the main internal mammary vessels.

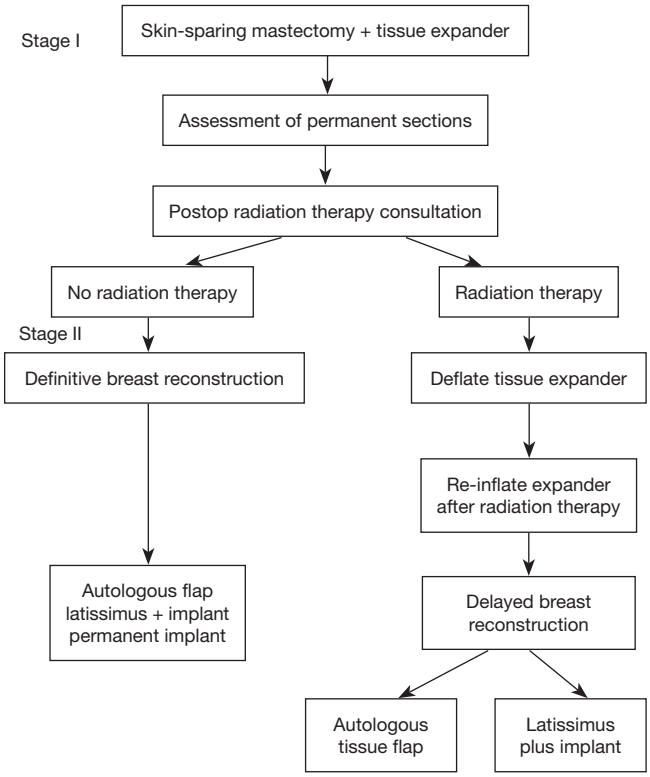

Figure 6 Delayed-immediate breast reconstruction.

Management of upper extremity lymphedema after treatment for breast cancer

One side effect of breast cancer treatment with mastectomy, axillary lymph node dissection, and radiation therapy is the development of upper extremity lymphedema. It is estimated that the incidence of breast-cancer related lymphedema is 8–30% in all breast cancer survivors. Koshima first reported the use of "super microsurgery" with lymph-venous bypass to treat lymphedema in 2000. Dr. David Chang first introduced this technique to MDACC and the United States in 2005 and published his experience in 2010 (29). Since then, management of lymphedema has become a hot topic throughout the world from anatomy, physiology, imaging, to clinical management (30-36). However, it is generally accepted that the effectiveness of lymphovenous bypass surgery is 50% at best and long-term results are still unclear. Lymphovenous bypass is less effective for long-standing lymphedema patients. For these patients, lymph node transfer may be a better alternative.

In summary, as the nation's premier cancer center, MDACC has extensive experience in breast reconstruction and its related issues, and has made significant contributions in the development and advancement of breast reconstruction and breast-cancer related lymphedema treatment.

Acknowledgements

None.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

References

1. Kroll SS, Ames F, Singletary SE, et al. The oncologic risks of skin preservation at mastectomy when combined with immediate reconstruction of the breast. Surg Gynecol Obstet 1991;172:17-20.
2. Miller MJ. Immediate breast reconstruction. Clin Plast Surg 1998;25:145-56.
3. Kroll SS, Schusterman MA, Tadjalli HE, et al. Risk of recurrence after treatment of early breast cancer with skin-sparing mastectomy. Ann Surg Oncol 1997;4:193-7.
4. Kroll SS, Khoo A, Singletary SE, et al. Local recurrence risk after skin-sparing and conventional mastectomy: a 6-year follow-up. Plast Reconstr Surg 1999;104:421-5.
5. Wagner JL, Fearmonti R, Hunt KK, et al. Prospective evaluation of the nipple-areola complex sparing mastectomy for risk reduction and for early-stage breast cancer. Ann Surg Oncol 2012;19:1137-44.
6. Kroll SS, Evans GR, Reece GP, et al. Comparison of resource costs between implant-based and TRAM flap breast reconstruction. Plast Reconstr Surg 1996;97:364-72.
7. Schusterman MA, Kroll SS, Reece GP, et al. Incidence of autoimmune disease in patients after breast reconstruction with silicone gel implants versus autogenous tissue: a preliminary report. Ann Plast Surg 1993;31:1-6.
8. Evans GR, Netscher DT, Schusterman MA, et al. Silicon tissue assays: a comparison of nonaugmented cadaveric and augmented patient levels. Plast Reconstr Surg 1996;97:1207-14.
9. Schusterman MA, Kroll SS, Weldon ME. Immediate breast reconstruction: why the free TRAM over the conventional TRAM flap? Plast Reconstr Surg 1992;90:255-61; discussion 262.
10. Baldwin BJ, Schusterman MA, Miller MJ, et al. Bilateral breast reconstruction: conventional versus free TRAM.

Plast Reconstr Surg 1994;93:1410-6; discussion 1417.
11. Schusterman MA, Kroll SS, Miller MJ, et al. The free transverse rectus abdominis musculocutaneous flap for breast reconstruction: one center's experience with 211 consecutive cases. Ann Plast Surg 1994;32:234-41; discussion 241-2.
12. Kroll SS, Schusterman MA, Reece GP, et al. Abdominal wall strength, bulging, and hernia after TRAM flap breast reconstruction. Plast Reconstr Surg 1995;96:616-9.
13. Kroll SS, Reece GP, Miller MJ, et al. Comparison of cost for DIEP and free TRAM flap breast reconstructions. Plast Reconstr Surg 2001;107:1413-6; discussion 1417-8.
14. Kroll SS. Fat necrosis in free transverse rectus abdominis myocutaneous and deep inferior epigastric perforator flaps. Plast Reconstr Surg 2000;106:576-83.
15. Wu LC, Bajaj A, Chang DW, et al. Comparison of donor-site morbidity of SIEA, DIEP, and muscle-sparing TRAM flaps for breast reconstruction. Plast Reconstr Surg 2008;122:702-9.
16. Chevray PM. Breast reconstruction with superficial inferior epigastric artery flaps: a prospective comparison with TRAM and DIEP flaps. Plast Reconstr Surg 2004;114:1077-83; discussion 1084-5.
17. Kronowitz SJ, Robb GL. Breast reconstruction and adjuvant therapies. Semin Plast Surg 2004;18:105-15.
18. Evans GR, Schusterman MA, Kroll SS, et al. Reconstruction and the radiated breast: is there a role for implants? Plast Reconstr Surg 1995;96:1111-5; discussion, 1116-8.
19. Tran NV, Chang DW, Gupta A, et al. Comparison of immediate and delayed free TRAM flap breast reconstruction in patients receiving postmastectomy radiation therapy. Plast Reconstr Surg 2001;108:78-82.
20. Kronowitz SJ, Chang DW, Robb GL, et al. Implications of axillary sentinel lymph node biopsy in immediate autologous breast reconstruction. Plast Reconstr Surg 2002;109:1888-96.
21. Tran NV, Evans GR, Kroll SS, et al. Postoperative adjuvant irradiation: effects on tranverse rectus abdominis muscle flap breast reconstruction. Plast Reconstr Surg 2000;106:313-7; discussion 318-20.
22. Kronowitz SJ, Hunt KK, Kuerer HM, et al. Delayed-immediate breast reconstruction. Plast Reconstr Surg 2004;113:1617-28.
23. Kronowitz SJ. Delayed-immediate breast reconstruction: technical and timing considerations. Plast Reconstr Surg 2010;125:463-74.
24. Kronowitz SJ, Robb GL. Radiation therapy and breast reconstruction: a critical review of the literature. Plast Reconstr Surg 2009;124:395-408.
25. Motwani SB, Strom EA, Schechter NR, et al. The impact of immediate breast reconstruction on the technical delivery of postmastectomy radiotherapy. Int J Radiat Oncol Biol Phys 2006;66:76-82.
26. Saint-Cyr M, Youssef A, Bae HW, et al. Changing trends in recipient vessel selection for microvascular autologous breast reconstruction: an analysis of 1483 consecutive cases. Plast Reconstr Surg 2007;119:1993-2000.
27. Saint-Cyr M, Chang DW, Robb GL, et al. Internal mammary perforator recipient vessels for breast reconstruction using free TRAM, DIEP, and SIEA flaps. Plast Reconstr Surg 2007;120:1769-73.
28. Sacks JM, Chang DW. Rib-sparing internal mammary vessel harvest for microvascular breast reconstruction in 100 consecutive cases. Plast Reconstr Surg 2009;123:1403-7.
29. Chang DW. Lymphaticovenular bypass for lymphedema management in breast cancer patients: a prospective study. Plast Reconstr Surg 2010;126:752-8.
30. Chang DW, Kim S. Breast reconstruction and lymphedema. Plast Reconstr Surg 2010;125:19-23.
31. Suami H, Chang DW, Yamada K, et al. Use of indocyanine green fluorescent lymphography for evaluating dynamic lymphatic status. Plast Reconstr Surg 2011;127:74e-76e.
32. Crosby MA, Card A, Liu J, et al. Immediate breast reconstruction and lymphedema incidence. Plast Reconstr Surg 2012;129:789e-95e.
33. Card A, Crosby MA, Liu J, et al. Reduced incidence of breast cancer-related lymphedema following mastectomy and breast reconstruction versus mastectomy alone. Plast Reconstr Surg 2012;130:1169-78.
34. Chang DW, Suami H, Skoracki R. A prospective analysis of 100 consecutive lymphovenous bypass cases for treatment of extremity lymphedema. Plast Reconstr Surg 2013;132:1305-14.
35. Althubaiti GA, Crosby MA, Chang DW. Vascularized supraclavicular lymph node transfer for lower extremity lymphedema treatment. Plast Reconstr Surg 2013;131:133e-5e.
36. Nguyen AT, Chang EI, Suami H, et al. An algorithmic approach to simultaneous vascularized lymph node transfer with microvascular breast reconstruction. Ann Surg Oncol 2015;22:2919-24.

Cite this article as: Yu P. Breast reconstruction at the MD Anderson Cancer Center. Gland Surg 2016;5(4):416-421. doi: 10.21037/gs.2016.05.03

