



## Breast Reconstruction: A Review of Current Technologies and the Effect on Patient Care

Myckatyn TM\* and Elizabeth Odom

Division of Plastic and Reconstructive Surgery, Washington University School of Medicine, USA

### Editorial

In an ever changing landscape of treatment and reconstruction of breast cancer, plastic surgeons have a challenging role to fulfill. With ease of access to educational materials, photographs, and surgical information via the internet, patients expect more involvement in major healthcare decisions and seem to be ever more educated and knowledgeable about their options. Furthermore, new technologies, improved imaging, and collaboration with physicians in a multidisciplinary care setting continue to shape and expand the field in which we practice. “Shared decision making” is a term of increasing familiarity as patients come to expect discussions regarding their options with utmost transparency from their provider, detailed information regarding each option, and to feel sincerely included in surgical planning and decision making. There is increasing complexity when it comes to navigating both the financial and personal aspects of breast cancer care, and in this editorial piece, we explore the technological changes and advancements in breast reconstruction as they affect the patient and surgeon - an ever evolving topic in our field.

### Initial Consultation

More than 50,000 women undergo breast reconstruction each year [1], and that number continues to rise with increasing awareness and availability of information via the Internet. The choice to undergo reconstruction – and which type of reconstruction – are highly personal decisions that will alter that are coupled with an emotionally-charged cancer (or high-risk for cancer) diagnosis. Breast cancer patients turn to online resources more frequently than the majority of patients, and it plays an influential role in their care [2]. Unfortunately, recent studies have shown that 46% of Americans have only low or marginal health literacy [3] and this is a strong contributor to health status and disparities in care. The readability of most print and electronic patient resources from both Internet searches and professional societies are too difficult to be understood by the majority of patients [4]. Therefore, patients now present for initial consultation with information regarding breast reconstruction and may have preconceived preferences and opinions regarding their options. Physicians may then abbreviate discussions regarding their choices and the implications, leading patients to walk away with inappropriate expectations, an incomplete understanding of their surgical options, or the long-term consequences of their decision. It has been shown that breast cancer patient expressed a strong need for preoperative information preoperatively delivered personally and slowly by their surgeon [5]. Properly-informed patients are more likely to have an improved quality of life and, attain a higher level of satisfaction, and thereby have better overall health outcomes [6-8]. When women are satisfied with preoperative information, preoperative regret diminished significantly [9]. An understanding of the patient’s level of knowledge and tailoring discussions to each patient is critical in setting expectations and delivering appropriate care to each individual.

This discussion would not be complete without the mention of social media and the role it plays in patient care. With pages of incomplete, incorrect or inappropriate information on the internet, social provides a potential platform for patients to receive information directly from our professional societies or a physician’s practice with updated photographs, links to valuable educational resources, and modules for decision-making and sharing of experiences [10]. While these forums certainly have the potential for abuse, easily-searchable sites such Facebook or Twitter could provide important and directed information that could benefit both physician and patient.

### Preoperative Planning

Use of further technological advancements in the preoperative period may also lead to improved patient outcomes and satisfaction. Masia et al. [11] found that preoperative computed tomographic

### OPEN ACCESS

#### \*Correspondence:

Terence M. Myckatyn, Division of Plastic and Reconstructive Surgery, Washington University School of Medicine, 660 South Euclid Ave., Campus Box 8238 St. Louis, MO 631101010, USA, Tel: (314) 283-9577; E-mail: myckatynt@wudosis.wustl.edu

Received Date: 17 May 2016

Accepted Date: 24 May 2016

Published Date: 31 May 2016

#### Citation:

Myckatyn TM, Odom E. Breast Reconstruction: A Review of Current Technologies and the Effect on Patient Care. Clin Surg. 2016; 1: 1036.

Copyright © 2016 Myckatyn TM. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

angiogram (CTA) has reduced average operative time and post-operative complications in deep inferior epigastric artery perforator (DIEP) flap reconstruction, in turn reducing overall cost of care. Rozen et al. [12] performed a cost analysis for the use of CTA in DIEP flap reconstruction and found a cost savings of \$, 410 per case by reduction in operative time and complications, providing incentive for insurance companies and hospitals to support its use. CTA may also be used to assess the feasibility of a superficial inferior epigastric artery flap for reconstruction prior to initiation of the case, which would also potentially impact patient expectations and ultimately their satisfaction with the reconstructive procedure [13].

Tailoring preoperative expectations through preoperative modeling of the reconstructed breast may also improve post-operative satisfaction by both patient and surgeon. In the past, MRI has been shown to accurately predict breast volume and has been used to predict implant size and model [14]. 3D surface imaging also shows promise in both aesthetic and reconstructive breast surgery. We have performed a recent study validating the Vectra 3D camera as an accurate assessor of breast specimen weight [15], and Szycha et al. [16] also validate and describe its use in two-stage implant reconstruction. 3D imaging allows surgeons and patients to better visualize breast size and key mammometric landmarks to better predict implant volume and shape. Studies have evaluated this imaging modality for initial autologous reconstruction, implant reconstruction, and for post-reconstruction revisions such as fat grafting [17]. The versatility of 3D imaging and the ability to objectively measure baseline volumes, asymmetries, and to simulate outcomes is invaluable in counseling patients about their options and expected outcomes.

Furthermore, Tonita et al. [18] recently published a patient series using 3D surface imaging to develop a printed mold to improve intraoperative shaping of the reconstructed breast to match the contralateral, unaffected side. Outcomes were excellent, and allows surgeons to adequately predict the necessary volume, projection, and shape – all of which may be discussed with the patient in the preoperative planning process. These advancements should continue to be explored to improve the preoperative planning process and open the dialog between physician and patient about desires and expectations with a personalized 3D model before them.

## Intraoperative Advancements

Improvements in intraoperative technology have also improved patient care and have the potential to dramatically reduce complications. Three-dimensional printing is an emerging technology that has shown promise in all fields of medicine. Mehta et al, describes using a 3D printed model generated from a CTA intraoperatively as a point of reference during DIEP dissection [19]. This tool may also aid trainees as they learn to visualize the intramuscular course of these delicate vessels.

While this technology is new and has not yet found its niche in breast reconstruction, more familiar to plastic surgeons is SPY, or laser-assisted angiography. The device utilizes laser-assisted detection of intravascular indocyanine green, with a short half-life and excellent safety profile, to determine areas of perfusion – and potentially hypoperfusion. This has been shown to be especially useful in immediate reconstruction, both prosthetic and autologous. In implant-based reconstruction, this technology minimizes late mastectomy flap necrosis and rates of nipple necrosis in nipple-sparing mastectomy [20,21]. In microvascular surgical reconstruction,

it has led to increasing flap viability and a decrease in overall flap complications [20,22].

## Postoperative Care

In the post-operative period, devices such as the implantable Doppler have been studied extensively [23-25]. As technology improves, new ideas show promise. “Apps” for smart phones are being developed daily and some of these are geared specifically toward monitoring of reconstructed breasts. Photographs are paramount in tracking postoperative progress, and the instant exchange of images between team members via smartphones allows for a consistency and continuity in care that is unsurpassed. It leads to a reduction in time to flap re-exploration and has improved flap salvage significantly [26,27]. SilpaRamanitor [28] is an application that is currently being developed that allows for remote monitoring of flap color and potential venous occlusion. It has been shown to detect venous changes significantly earlier than clinical observation allowing for earlier intervention. It has shown to be 94% sensitive and 98% specific in analysis of skin color in the setting of free-flap reconstruction.

Furthermore, after discharge, patients are increasingly using digital photography and smartphones to communicate any physical changes in their surgical site with their physician and such communication has been shown to greatly enhance the physician-patient relationship [29]. Similar to the shared-decision-making model in preoperative planning, patients are ever more aware of post-operative changes and desire thorough communication. Rao et al. [30] demonstrated a reduced number of clinic visits, fewer days of drain requirements, and increased efficacy of physician visits using a multimedia messaging system. While there are gray areas in this sort of communication in terms of what is defined as part of the official “medical chart”, and physicians must always conform to HIPPA standards, prompt communication in the perioperative period can benefit not only the patient, but family, caregivers and nursing staff.

## Conclusions

In conclusion, rapid advancements in technology continue to shape the field of breast reconstruction from the initial consultation until well into the post-operative period. The improvements in existing technology and new developments discussed here have been shown to improve efficiency, are cost-effective, and improve patient satisfaction. Remaining abreast of these changes will serve to benefit both the physician and the population of patients under his or her care.

## References

1. Cordeiro PG. Breast reconstruction after surgery for breast cancer. *N Engl J Med.* 2008; 359: 1590-1601.
2. Losken A, Burke R, Elliott LF 2nd, Carlson GW. Infonomics and breast reconstruction: are patients using the internet? *Ann Plast Surg.* 2005; 54: 247-250.
3. Paasche-Orlow MK, Parker RM, Gazmararian JA, Nielsen-Bohlman LT, Rudd RR. The prevalence of limited health literacy. *J Gen Intern Med.* 2005; 20: 175-184.
4. Vargas CR, Katak NA, Chuang DJ, Koolen PG, Lee BT. Assessment of online patient materials for breast reconstruction. *J Surg Res.* 2015; 199: 280-286.
5. Tsianakas V, Robert G, Maben J, Richardson A, Dale C, Griffin M, et al. Implementing patient-centred cancer care: using experience-based co-design to improve patient experience in breast and lung cancer services. *Support Care Cancer.* 2012; 20: 2639-2647.

6. Durand MA, Carpenter L, Dolan H, Bravo P, Mann M, Bunn F, et al. Do interventions designed to support shared decision-making reduce health inequalities? A systematic review and meta-analysis. *PLoS One*. 2014; 9: e94670.
7. Ashraf AA, Colakoglu S, Nguyen JT, Anastasopoulos AJ, Ibrahim AM, Yueh JH, et al. Patient involvement in the decision-making process improves satisfaction and quality of life in postmastectomy breast reconstruction. *J Surg Res*. 2013; 184: 665-670.
8. Temple-Oberle C, Ayeni O, Webb C, Bettger-Hahn M, Ayeni O, Mychailyshyn N. Shared decision-making: applying a person-centered approach to tailored breast reconstruction information provides high satisfaction across a variety of breast reconstruction options. *J Surg Oncol*. 2014; 110: 796-800.
9. Zhong T, Bagher S, Jindal K, Zeng D, O'Neill AC, MacAdam S, et al. The influence of dispositional optimism on decision regret to undergo major breast reconstructive surgery. *J Surg Oncol*. 2013; 108: 526-530.
10. Rohrich RJ, Weinstein AG. Connect with plastic surgery: social media for good. *Plast Reconstr Surg*. 2012; 129: 789-792.
11. Masia J, Kosutic D, Clavero JA, Larranaga J, Vives L, Pons G. Preoperative computed tomographic angiogram for deep inferior epigastric artery perforator flap breast reconstruction. *J Reconstr Microsurg*. 2010; 26: 21-28.
12. Rozen WM, Ashton MW, Whitaker IS, Wagstaff MJ, Acosta R. The financial implications of computed tomographic angiography in DIEP flap surgery: a cost analysis. *Microsurgery*. 2009; 29: 168-169.
13. Piorkowski JR, DeRosier LC, Nickerson P, Fix RJ. Preoperative computed tomography angiogram to predict patients with favorable anatomy for superficial inferior epigastric artery flap breast reconstruction. *Ann Plast Surg*. 2011; 66: 534-536.
14. Kim H, Mun GH, Wiraatmadja ES, Lim SY, Pyon JK, Oh KS, et al. Preoperative magnetic resonance imaging-based breast volumetry for immediate breast reconstruction. *Aesthetic Plast Surg*. 2015; 39: 369-376.
15. Odom EB, Poppler L, Linkugel A, Myckatyn TM. Validity of Vectra 3D Imaging for Breast Volume. 2016.
16. Szycha P, Raine C, Butterworth M, Stewart K, Witmanowski H, Zadrozny M, et al. Preoperative implant selection for two stage breast reconstruction with 3D imaging. *Comput Biol Med*. 2014; 44: 136-143.
17. O'Connell RL, Stevens RJ, Harris PA, Rusby JE. Review of three-dimensional (3D) surface imaging for oncologic, reconstructive and aesthetic breast surgery. *Breast*. 2015; 24: 331-342.
18. Tomita K, Yano K, Hata Y, Nishibayashi A, Hosokawa K. DIEP Flap Breast Reconstruction Using 3-dimensional Surface Imaging and a Printed Mold. *Plast Reconstr Surg Glob Open*. 2015; 3: e316.
19. Mehta S, Byrne N, Karunanithy N, Farhadi J. 3D printing provides unrivalled bespoke teaching tools for autologous free flap breast reconstruction. *J Plast Reconstr Aesthet Surg*. 2016; 69: 578-580.
20. Komorowska-Timek E, Gurtner GC. Intraoperative perfusion mapping with laser-assisted indocyanine green imaging can predict and prevent complications in immediate breast reconstruction. *Plast Reconstr Surg*. 2010; 125: 1065-1073.
21. Gurtner GC, Jones GE, Neligan PC, Newman MI, Phillips BT, Sacks JM, et al. Intraoperative laser angiography using the SPY system: review of the literature and recommendations for use. *Ann Surg Innov Res*. 2013; 7: 1.
22. Yamaguchi S, De Lorenzi F, Petit JY, Rietjens M, Garusi C, Giraldo A, et al. The "perfusion map" of the unipedicled TRAM flap to reduce postoperative partial necrosis. *Ann Plast Surg*. 2004; 53: 205-209.
23. Chang EI, Ibrahim A, Zhang H, Liu J, Nguyen AT, Reece GP, et al. Deciphering the Sensitivity and Specificity of the Implantable Doppler Probe in Free Flap Monitoring. *Plast Reconstr Surg*. 2016; 137: 971-976.
24. Kempton SJ, Poore SO, Chen JT, Afifi AM. Free flap monitoring using an implantable anastomotic venous flow coupler: Analysis of 119 consecutive abdominal-based free flaps for breast reconstruction. *Microsurgery*. 2015; 35: 337-344.
25. Jandali S, Wu LC, Vega SJ, Kovach SJ, Serletti JM. 1000 consecutive venous anastomoses using the microvascular anastomotic coupler in breast reconstruction. *Plast Reconstr Surg*. 2010; 125: 792-798.
26. Engel H, Huang JJ, Tsao CK, Lin CY, Chou PY, Brey EM, et al. Remote real-time monitoring of free flaps via smartphone photography and 3G wireless Internet: a prospective study evidencing diagnostic accuracy. *Microsurgery*. 2011; 31: 589-595.
27. Hwang JH, Mun GH. An evolution of communication in postoperative free flap monitoring: using a smartphone and mobile messenger application. *Plast Reconstr Surg*. 2012; 130: 125-129.
28. Kiranantawat K, Sitpahul N, Taepasartsit P, Constantinides J, Kruavit A, Srimuninnimit V, et al. The first Smartphone application for microsurgery monitoring: SilpaRamanitor. *Plast Reconstr Surg*. 2014; 134: 130-139.
29. Al-Hadithy N, Ghosh S. Smartphones and the plastic surgeon. *J Plast Reconstr Aesthet Surg*. 2013; 66: e155-161.
30. Rao R, Shukla BM, Saint-Cyr M, Rao M, Teotia SS. Take two and text me in the morning: optimizing clinical time with a short messaging system. *Plast Reconstr Surg*. 2012; 130: 44-49.