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

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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 affects 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

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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 insentive 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 patientsto 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, orlaser-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.

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