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Trends and Concepts in Post-Mastectomy Breast Reconstruction

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Abstract

A number of factors have contributed to a paradigm shift in US post-mastectomy breast reconstruction. The increasing numbers of contralateral prophylactic mastectomies strongly correlated to a rise in implant-based reconstructions. Autologous reconstruction, however, has faced a number of barriers including technically complicated perforator flaps and declining reimbursements. As such, a market concentration has developed within high volume microsurgical centers. As more patients receive radiation, the timing and method of reconstruction has become a controversial topic.

Keywords

Breast Reconstruction; Radiation; Post-Mastectomy; and Trends

Introduction

The American Cancer Society reported an estimated 231,840 new cases of invasive breast cancer and 60,290 new cases of in situ breast disease among women in the United States for 2015 [1]. Of these, 30–40% will undergo a total mastectomy and historically 25% will have immediate reconstruction [2]. Aspects of post-mastectomy breast reconstruction have changed over the past 10 years that significantly impacts how we treat women diagnosed with breast cancer. The current report reviews concepts and controversies surrounding post-mastectomy breast reconstruction.

Rise in the Use of Implant-Based Reconstruction

A longitudinal analysis of patients undergoing total mastectomy between 1998 and 2008 was performed using the Nationwide Inpatient Sample (NIS) Database [2], the largest all payer in-patient database available in the United States. The study showed a 78 percent increase in rates of immediate breast reconstruction over the study period. While prosthetic techniques increased on average 11% per year, the rates of autologous reconstruction were unchanged.

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Reasons for the rise in rates of immediate reconstruction are multifactorial. It has been well established that breast reconstruction following mastectomy improves body image, self-esteem, sexuality and quality of life [3]. Moreover, insurance coverage for breast reconstruction after mastectomy was ensured with passage of the Women's Health and Cancer Rights Act of 1998 [4, 5]. Increasing public awareness about breast cancer reconstruction has pushed legislation even further in individual states to mandate that breast reconstruction be discussed with all patients [4–6]. Another factor leading to greater reconstruction rates is that women younger than age 49 years represent an increasing proportion of patients undergoing mastectomy[5]. This likely reflects larger numbers of women undergoing risk-reducing mastectomies.

The paradigm shift from autologous to prosthetic techniques is perhaps the most important change in post mastectomy breast reconstruction [5]. The information from the NIS showed that the strongest predictors for increasing immediate implant based reconstruction were procedures performed more recently in the study period, Medicare recipients compared to private insurance carriers, and bilateral mastectomy defects.

Influence of Changing Mastectomy Patterns on Reconstruction Rates

Bilateral mastectomies in the form of either contralateral prophylactic mastectomy (CPM) for patients with unilateral breast cancer or as a bilateral prophylactic mastectomy (BPM) for those with genetic mutations have increased significantly by 15 percent and 12 percent per year, respectively [7]. In contrast, unilateral mastectomies decreased on average 2 percent per year [7]. The choice between a CPM or a unilateral mastectomy is complex involving many factors. The Nationwide Inpatient Sample database showed that women younger than 39 years were 1.2 times more likely to choose CPM than women aged 40 to 49. This may be attributable to the increased risk of contralateral second primary breast cancers in women diagnosed before age 40 years [8–11]. When comparing Caucasian and Hispanic women to African American women, the study showed that the former groups have an increased likelihood of CPM suggesting the influence of cultural backgrounds on decision-making for CPM. Health insurance type was also associated with the decision to proceed with CPM, as women with private insurance relative to Medicaid may be offered broader indications for these procedures. For example, private insurance providers cite the Society of Surgical Oncology position statement, which states that, “CPM may be considered for improved symmetry in patients with a large and/or ptotic contralateral breast, or disproportionately sized contralateral breast.” Medicaid has no similar policy to cover CPM [12–14]. There has also been an increased likelihood for CPM in academic centers reflecting greater available economic and human resources such as trainees who can assist in the workload of bilateral autologous procedures. Finally, regional variation in CPM use is likely multifactorial, attributable to individual biases by patients, physicians, or institutions.

Another interesting trend is that women are increasingly selecting bilateral mastectomy instead of breast conserving therapy (BCT) despite the same long-term survival [15]. In a study by Albornoz, the authors sampled the National Cancer Data Base (NCDB), a joint initiative of the Commission on Cancer, the American College of Surgeons, and the American Cancer Society [16]. The NCDB is a nationwide oncology outcomes database for

more than 1500 Commission-accredited cancer programs. Following several years of decreasing use, rates of mastectomy for management of early-stage breast cancer have risen since 2005. The study was novel in that it demonstrated a decrease in BCT, but without a corresponding increase in unilateral mastectomy. Rather patients appear to be deciding between BCT and contralateral prophylactic mastectomy.

It is unclear why more women are choosing aggressive surgical treatment for early-stage breast cancer. Most bilateral mastectomies with CPM are performed in patients who are at low risk of developing contralateral cancer. Although the 10-year risk of contralateral cancer is approximately 5 percent, newly diagnosed patients tend to overestimate their level of risk. Other reasons patients cite for choosing CPM include achieving “peace of mind,” avoidance of ongoing surveillance and diagnostic procedures, and desire for breast symmetry following reconstruction. Furthermore, improvements in mastectomy techniques (e.g. skin-sparing and nipple-sparing), reconstructive techniques (e.g. perforator flap autologous reconstruction), and improved implant technology may make CPM an increasingly attractive option for women.

Broadening Implications for Implant-Based Reconstruction

Another reason for the rise in implants reconstruction is that there is a greater willingness of reconstructive surgeons to offer this treatment to high-risk patients, including those that require radiation. Breast reconstruction trends in patients with and without high-risk features were analyzed using NCDB [17]. High-risk features included elderly (older than 60 years old), advanced disease (AJCC 7th edition stage III or IV), any comorbidities, and use of post-mastectomy radiotherapy and pre-mastectomy radiotherapy. Information from over 1 million breast cancer patients treated with mastectomies from 1998 to 2011 showed that high-risk features were present in 49.3% of the cohort, with post-mastectomy radiation present in 19.2% [17]. Reconstruction rates for both low- and high-risk groups increased, but to a greater extent in the high-risk groups. The change in the surgeon and patient’s attitude favouring reconstruction is important because the high-risk population represents approximately 50% of the mastectomy pool.

The findings lend support to the hypothesis that reconstruction in high-risk patients is a contributing factor to the preferential expansion of prosthetic relative to autologous techniques within the United States. The study further shows that the overall prosthetic techniques were chosen as the method of reconstruction in 93.6% of high-risk patients throughout the 12-year study period. Although long-term satisfaction and quality of life are greater with autologous reconstruction, implants are a reasonable option for high-risk patients as a safe, reliable, and efficient way of restoring body image. Implant reconstruction is less invasive than autologous procedures, has shorter operative time and recovery period, absent donor site morbidity, and easy removal in cases of failure.

For example, even as few as 10 years ago, the need for adjuvant radiation therapy was considered by many surgeons to be an absolute contraindication to immediate tissue expander and implant reconstruction. However, reports from high- volume centers

demonstrating feasibility, adequate cosmesis, and acceptable complication rates have led to more widespread adoption of this approach.

Barriers to Autologous Reconstruction

As stated previously, despite increasing implant-based reconstruction, autologous reconstruction remains stable over the past 10 years [5]. The NIS showed that by 2008, immediate implants outnumbered autologous reconstructions by a ratio of 2:1 (258 versus 120 per 1000 mastectomies) [5]. The unchanged rate of autologous reconstruction is surprising considering the higher long-term satisfaction and more stable aesthetic results [18, 19]. As a plastic surgeon, one would presume that the many refinements in microsurgery, such as the advent of perforator flaps to decrease abdominal wall morbidity, would increase the use of autologous tissue. However, a number of barriers to autologous reconstruction have been identified [5]. One obstacle includes limited operating room availability and time for autologous reconstruction. For example, a pedicled TRAM takes approximately 4hrs versus unilateral tissue expander, which takes about 1 hr. This does not take into account the time taken to do DIEP reconstruction, which can take more than 6hrs. In addition, the use of perforator flap techniques calls for microsurgical expertise. There are also subsets of plastic surgeons that do not offer microsurgical reconstruction as evidenced by referral patterns. Interestingly, there are limited centers offering microsurgical expertise with a market concentration to academic centers [20]. Moreover, higher volume reconstruction centers have been shown to have lower complication rates than low volume counterparts when performing autologous reconstruction [21].

Another barrier for autologous reconstruction potentially stems from the financial reimbursements for these procedures. Medicare payments for autologous reconstruction have decreased over the past 10 years, yet remains unchanged for private carriers [22, 23]. Private insurance payment for implant reconstruction increased by 64 percent from 1997 to 2007, whereas autologous reconstruction reimbursement was level [22]. Differential surgeon compensation favoring implants (\$587 per hour versus \$322 per hour for autologous tissue) for patients with private insurances and the extra operative time required to complete an autologous reconstruction may be additional factors contributing to the lack of rise in autologous reconstruction [22].

Post-Mastectomy Radiation and its Reconstructive Considerations

The use of postmastectomy radiation therapy (PMRT) continues to expand as indications have broadened. Current indications include tumour size 5 cm or less and one to three positive nodes [24]. The increase in immediate implant-based reconstruction rates by 200 percent in the past 10 years and expanding use of radiotherapy imply that more implant reconstructions will probably be exposed to the effects of radiation every year.

In general the timing of radiotherapy is dictated by whether or not patients require neoadjuvant chemotherapy[25]. For those requiring neoadjuvant chemotherapy, radiation therapy is delivered to the tissue expander before the exchange of tissue expander for permanent devices. If adjuvant chemotherapy is delivered, radiation can be delivered either

before or after the exchange procedure to permanent implant. In a study by Cordeiro et al, the authors sampled patients who underwent prosthesis-based reconstruction without radiation therapy, radiation therapy to the tissue expander, or radiation therapy to the permanent implant from 2003 to 2012 [25]. The study showed that patients who receive radiation therapy to the tissue expander are significantly more likely to lose the tissue expander than those with radiation therapy to the final implant (8.5 percent versus 1.0 percent). This finding may simply reflect that the tissue expander remains in place for a lengthier period in the radiation therapy to the tissue expander group than in the radiation therapy to the permanent implant group (13.2 versus 6.2 months). The results are supported by recent studies, including a systematic review [26, 27]. In the report by Nava et al. (2010), they recruited 257 consecutive patients undergoing PMRT to the tissue expander (50) or the implant (109). They found that total failure rate was significantly higher in patients having their tissue expander vs the implant radiation (40% vs 6.1%) [27]. In a systematic review by Lam et al., the authors found that radiating the tissue expander had a higher failure rate than radiating the implant [26].

Importantly, the study by Cordeiro et al, showed that patients undergoing radiation to the tissue expander had a greater proportion of very good to excellent aesthetic results compared to patients with permanent implant radiation (75.0 percent versus 67.6 percent; $p < 0.01$) and lower rates of grade IV capsular contracture ($p < 0.01$). Lower rates of severe capsular contracture in the radiation therapy to the tissue expander group are likely due to the aggressive capsulotomy performed at the time of the exchange procedure. Therefore, patients who undergo prosthetic breast reconstruction must weigh the trade-offs associated with different options for timing of radiation delivery. Radiation to the permanent implant is associated with less risk of failure, but better aesthetic outcomes and less capsular contracture. Decision-making should be made in a shared process between patient and physician.

The high rates of complications associated with radiation therapy and implant-based reconstruction has lead some Plastic Surgeons to favor autologous reconstruction.; however, the impact of radiation on autologous tissues remains unclear. Schaverien et al. performed a recent systematic review to evaluate the reported effects of postoperative radiotherapy on immediate autologous breast reconstruction[28]. The authors identified 25 observational studies, none of which were randomized-control trials. The pooled data showed no significant difference in the prevalence of overall complications or revision surgery for immediate autologous breast reconstruction with or without postoperative radiotherapy, but a significantly higher prevalence of fat necrosis in the radiotherapy group. When comparing immediate reconstruction and postoperative radiotherapy compared with delayed reconstruction following mastectomy and radiotherapy, studies revealed no significant differences in the prevalence of overall complications and fat necrosis between the groups, but a significantly higher number of revisional surgeries in the immediate reconstruction group. Conclusions are limited because of the lack of high quality data, limited follow up periods and absence of randomised-controlled trials on the topic.

Future of Post-Mastectomy Reconstruction: Non-abdominal Based Tissue Transfer

The gold standard donor site for autologous breast reconstruction is the abdomen; however, when the patient has a thin body habitus, alternative donor sites are utilized. This includes but is not limited to the buttocks, thighs, back, and flanks regions [29, 30]. The technical expertise required for flap harvest at non-abdominal donor sites may further restrict autologous reconstruction to high volume microsurgical centers. Another challenge to autologous breast reconstruction is the ability to replace large breasts. When donor site tissue is limited in volume, stacked flaps have been used. This technique advocates for the use of multiple free flaps for a single-sided breast reconstruction. Such a complex method of breast reconstruction has a number of implications. The most significant being the demands it places on delivery of this type of health care to the entire population. This has placed greater pressure on plastic surgeons to be adept at microsurgery and become more efficient.

Summary

Over the past decade, prosthetic techniques have become the method of choice for post-mastectomy reconstruction in over 70% of cases. The rate of autologous reconstruction, which provides the most aesthetic and durable reconstruction, has not changed. Reasons for increased implant use are multifactorial, but include changes in oncologic practice, such as greater number of bilateral mastectomies and broader indications for PMRT. As implant reconstructions are increasingly subjected to the effects of radiation, aesthetic outcomes and complications have been compromised. In most instances the method and timing of breast reconstruction will remain a preference sensitive decision made in a shared process between the patient and her reconstructive surgeon.

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Synopsis

Over the past 10 years, rates of post-mastectomy breast reconstruction using implants have increased while use of autologous techniques is relatively unchanged. As greater numbers of women are receiving post-mastectomy radiation, the timing of reconstruction and method chosen should be considered in a shared decision-making process between patient and surgeon.

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