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Review

Breast reconstruction with breast implants

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Summary. *Background:* Breast cancer is the most common noncutaneous malignancy among women worldwide. After a breast cancer removal procedure, women are asked to decide about breast reconstruction, mainly to improve their life quality, and they can choose from among many options. Broadly, there are two different types of breast reconstruction procedures: prosthetic implant-based reconstruction and autologous tissue-based reconstruction. *Methods:* Implant-breast reconstruction is a minimally invasive procedure compared with autologous breast reconstruction. It is associated with fewer short- and long-term complications. *Results:* The ideal candidates for implant-based reconstruction are patients with non-redundant soft tissue coverage, who desire a moderate sized non-ptotic breast and have not been previously irradiated. *Conclusion:* The state of the art for implant-breast reconstruction is briefly described in this article. (www.actabiomedica.it)

Key words: breast recostruction, breast implants, oncoplastic surgery

Introduction

Breast cancer is the most common noncutaneous malignancy among women worldwide and accounts for the majority of cancer-related deaths among women (1). Presently, breast cancer affects 30% of women over the age of 70 years (6). Even though the incidence of breast cancer has been gradually increasing worldwide at a rate of approximately 1% per year (2), the death rate has been decreasing (3) due to the introduction of new and effective treatment regimens that prolong survival and also improve quality of life (4). The lifetime incidence of breast cancer for American women is approximately 1 in 8. The highest breast cancer incidence rates are seen in women aged 40 years and older; however, for African-American women, the incidence is higher from 50 to 59 years (5). The management of breast cancer requires different surgical approaches. Broadly, there are two different types of breast reconstruction: prosthetic implant–based reconstruction and autologous tissue–based reconstruction (7). As pointed out by Jewell et al. (20), compared to autologous flaps reconstruction, implant reconstruction is a minimally invasive procedure. This technique can be employed in any patient as long as she has not been irradiated previously. Breast reconstruction using breast implants can restore the natural feel, size, and shape of the breast (9). Implant-based breast reconstruction is most easily performed following modified radical mastectomy (8) and nipple- and skin-sparing mastectomy (7, 10, 11). With the use of silicone tissue expanders, which were first used for breast reconstruction by Radovan in 1978 (17) and Austad in 1979 (18, 19), implant breast reconstruction has become the most commonly used method for immediate and delayed postmastectomy breast reconstruction (8).

In this article, the state of the art for implant-breast reconstruction is briefly described.

Methods

Types of breast reconstruction

Breast reconstruction can be performed any time after removal of glandular tissue. In immediate breast reconstruction, the reconstruction is performed concurrently with the oncological procedure, whereas in delayed breast reconstruction the procedure is performed after adjuvant treatment (chemotherapy or radiotherapy) has been completed (21). Breast reconstruction can be performed as a one-step procedure with the placement of permanent implants, or as a two-step procedure, with initial placement of expander implants followed, some months later, by the placement of permanent implants. A combined reconstruction can also be performed, using both implants and autologous tissue. In any breast reconstructive surgery, a contralateral adjustment may be necessary, and patients undergoing breast reconstruction, especially a unilateral procedure, must be willing to accept that contralateral breast augmentation or reduction, or a mastopexy, may be necessary.

Generally, due to the lack of soft tissue coverage resulting from the mastectomy, partial or complete muscle coverage is necessary to limit implant visibility or exposure. Chao et al. (1) have described how implants are usually placed in a submuscular pocket rather than in a subcutaneous pocket.

Standard pocket dissection

Generally, the lateral edge of the pectoralis major muscle is elevated and a submuscular pocket is dissected, which extends medially up to the sternal edge and superiorly up to the second rib. Superiorly, the dissection is carried out in the relatively avascular plane between the pectoralis major and minor muscles. Inferiorly, the pocket dissection is carried out up to the upper margin of the sixth rib in the meridian of the breast. In general, the inframammary fold can be reliably reconstructed in this location. In addition, the lower slips of the serratus anterior are elevated to cover the infralateral expander. An acellular dermal matrix (13) may be used to avoid the need for elevation of the rectus fascia and the serratus anterior and/or the pectoralis minor muscles. Hospitalization for implant-based breast reconstruction usually lasts 3.5 days (14).

Selection of patients

The ideal candidates for implant-based reconstruction are patients with non-redundant soft tissue coverage, who desire a moderate sized non-ptotic breast and who have not been previously irradiated. A one-step immediate reconstruction with a standard implant is suitable for patients left with an appropriate amount of skin after mastectomy or those who have had skin-sparing or nipple-sparing mastectomy (7). Tanos et al. (14) have argued that skin-sparing mastectomy followed by immediate reconstruction provides the best aesthetic outcomes.

The two-step reconstruction, using expanders and implants, is recommended for women left with an unsuitable amount of skin for an immediate closure after implants placement or after major skin resection (15). The second stage breast reconstruction is commonly performed 6 months after the tissue expansion procedure has ended. At this surgery, the expander is removed and replaced by a permanent anatomical implant; a partial or total capsulectomy is also performed so that the permanent prosthesis is perfectly accommodated in the pouch, without any possibility of rotation or displacement. Usually, the access to the implant pocket is located at the inframammary crease, so this technique allows the surgeon to recreate the crease (16).

A delayed breast reconstruction may be necessary for several reasons; for example, reconstruction may be delayed to allow completion of chemotherapy or radiotherapy; it may because of the patient's preference (for psychological or other reasons); or it may be because mastectomy was performed by surgeons not prepared for breast reconstructions.

Oncoplastic surgery

Through improved screening and early detection, approximately 80% of women are nowadays diagnosed with small tumors that are amenable to treatment with breast-conservation surgery. Oncoplastic surgery, which was introduced by Audretsch et al. (22) in

1993, incorporates a variety of techniques for reducing deformities following breast cancer removal. These techniques draw from the principles inherent to plastic surgery procedures on the breast, such as breast reduction or mastopexy (23, 24).

Achieving volumetric symmetry

In breast reconstruction, the principle aesthetic objective is the restoration of volumetric symmetry. Various methods for breast volume measurement have been described that can help achieve symmetry following breast reconstruction. These include radiological methods (ultrasonography, mammography, CT, and MRI) as well as nonradiological methods (anthropometric measurements, liquid volume displacement, thermoplastic methods, and variations in light-based 3D scanners) (25). According to Raposio et al. (26), to achieve good symmetry after oncological surgery for breast cancer, it is necessary to determine the precise dimensions and volume of the expander so that the most appropriate implant can be chosen, i.e., one that best matches the dimensions of the contralateral breast. Raposio and colleagues (27) suggested the use of computer programs that can match the volume of the final implant with the contralateral breast, employing only two parameters-the half-circumference and the projection of the contralateral breast in the supine position. Osman et al. (28) used CT scans to measure the volume of the contralateral normal breast, and these volume estimates were used to establish the proper implant size. They noted that breast volumes obtained with CT scans were highly related to the volumes measured with two nonradiological methods (water displacement and anthropometric measurements) and argued that CT imaging is a feasible method for contralateral normal breast volume measurement in these patients.

In order to locate implants appropriately and achieve the desired aesthetic results, preservation of the inframammary fold or its re-establishment seems to be crucial. For satisfying long-term results, Fan et al. (8) suggested textured expanders due to their rough surface, which tend to remain fixed to their surrounding and will stay in place whereas a smooth tissue expander often does not. Furthermore, a 3-months wait between the last filling and the expanders' replacement with a textured anatomical gel-filled implant, allows to recreate a well-defined inframammary fold, improving reconstructed breast's inferior projection.

Autologous fat grafting

Autologous fat grafting is another method that is gaining popularity for breast reconstruction (29). Breast lipofilling is performed worldwide in thousands of patients every year, either as an alternative to implant placement for breast augmentation (30) or for restoration of the normal contour in an area of deformity after breast reconstruction. Several studies have examined the oncologic safety of breast lipofilling. Rigotti et al. (31), after 7.6 years of follow-up of 137 radical mastectomy patients who underwent fat grafting, did not find increased risk of cancer in these patients as compared with a nontreated group. However, Petit et al. (32), in a follow-up retrospective study of 59 patients, found that patients undergoing breast lipofilling had an 18% cumulative 5-year risk of locoregional recurrence vs. a 3% risk in patients who did not undergo lipofilling. On the other hand, Kronowitz et al. (33) in a controlled study observed locoregional recurrence in 1.3% (9/719) breasts treated with lipofilling breast reconstruction vs. 2.4% (16/670) breasts treated with non-lipofilling breast reconstruction. Their study found no increase in locoregional recurrence, systemic recurrence, or second breast cancers.

Howes et al. (34) reported the first case of a patient who had a single-stage large-volume breast reconstruction with autologous fat grafting after rotation flap approach (RoFA) mastectomy. Outcome was assessed by using a validated 3D laser scan technique for quantitative breast volume measurement. There are experimental studies (35) demonstrating that supplementation of adipose progenitor cells enhances the volume or weight of the surviving adipose tissue. This new approach of autologous fat grafting is called cell-assisted lipotransfer (CAL) (29, 35) and involves the concurrent transplantation of aspirated fat tissue and adipose progenitor cells. This supplementation of vascular stromal fraction containing adipose progenitor cells may boost the efficacy and safety of lipoinjection to the breasts. Various authors have described the

efficacy of fat grafting in radiated breasts. Rigotti et al. (36) showed the advantages provided by adipose-derived stem cells for improving capsular contracture and restoring ischemic tissue vascularization and organ function by recruitment of endothelial progenitor cells. Raposio et al. (37-39) proved the benefits given by adipose-derived stem cells while differentiating into mature endothelial cells and promoting neo-angiogenesis, suggesting its topical application in ischemic tissues.

Complications following breast reconstruction

Local complications after implant-breast reconstruction include rupture, capsular contracture, disfigurement, seroma, and infection, each of which could necessitate medical interventions and repeat surgeries (40). Capsular contracture, with an incidence of 0.6%-30%, is the most common complication following reconstructive breast surgery (41). Currently, patients are advised that they will likely require a reoperation for contracture at 15 years with an incidence of 1% per breast per year (42). Nava et al. (43) showed how radiotherapy increases the risk of complications by more than 40% in prosthetic-based reconstructions, increasing the rate of capsular contractures to between 25% and 30% of patients. Lipa et al. (44) described the presence of high levels of proteins, such as phospho-GSK-3beta, total GSK-3beta, beta-catenin, COX-2, and collagen type I and type III, in the radiated capsule, proving that radiotherapy increases the production of proteins that can determine capsular contracture. Other studies (45, 46) have shown that the periprosthetic capsule contains high levels of transforming growth factor (TGF)-β which causes the development of fibrous tissue by activating inflammatory cells and fibroblasts.

According to Chung et al. (47), simvastatin reduces radiation-induced capsular fibrosis around silicone implants in rats. Administration of simvastatin at a dose of 15 mg/kg/day in rats by oral gavage, was able to suppress capsular fibrosis through down-regulation of mRNA expression of CTGF and TGF-β1, decreasing the production of fibrogenic cytokines and thus reducing periprosthetic fibrosis. Their study laid the foundations for the use of simvastatin oral therapy to prevent or treat periprosthetic capsular formation.

Many studies have investigated the relationship between contracture and implant surface texture, bacterial colonization, location of implant placement, and type of implant filler material. There is evidence to suggest that silicone implants with textured surfaces are associated with significantly less capsular contracture than implants with smooth surfaces (48). Furthermore, anatomic implants have been linked with worse outcomes than round implants (9).

Acellular dermal matrices

The introduction of acellular dermal matrices has revolutionized the field of breast surgery. Acellular dermal matrices are currently used to recreate a large pocket for permanent implants, and thus help avoid the need for lifting the serratus anterior muscle (49-50). Maxwell et al. with their 13 years experience, proved how acellular dermal matrices significantly decreases capsular contracture risk, because it is probably able to reduce foreign body inflammatory response (51). They also supported the necessity of further long-term studies.

Psychosocial benefits of breast reconstruction

Breast reconstruction has been proved to have a positive effect on the psychological well-being of women with breast cancer. Rozen et al. (52) performed a review to evaluate the psychosocial need for immediate breast reconstruction and the issues surrounding oncologic safety. Their review concluded that immediate reconstruction does not increase local recurrence rates and does not delay the initiation of adjuvant chemotherapy or radiation. On the other hand, immediate breast reconstruction has a positive effect on psychosocial outcomes including depression, anxiety, body image, self-esteem, self-image, emotional function, social function, and sexual function.

Conclusion

Breasts are considered a symbol of femininity and therefore their loss may cause major psychological distress in a woman, damaging self image as well

as sexual life. After a breast cancer removal procedure, women are offered the option of breast reconstruction, which can help improve their quality of life. Implant-based reconstruction, however, should not be considered a second line of therapy. Early diagnosis allows the performance of procedures such as skin-sparing mastectomy and nipple-areola-sparing mastectomy, which permit to perform a conservative surgery with an immediate implant breast reconstruction.

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