

Post-Mastectomy Implant Selection in Single-Stage Unilateral Immediate Breast Reconstruction

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IMPORTANCE Incidence of implant based postmastectomy breast reconstruction is increasing as skin sparing mastectomies are proven oncologically safe. The choice of implant is multifactorial, including patients' factors, oncological factors and surgeons' preferences. Traditionally, anthropometric measurements have been used for implant selection, and volumetric measurements are least emphasized. Recently, more work is being done for calculation of breast volume and hence implant volume other than implant base width measurements. The present article discusses the recent studies for the calculation of breast implant volume in case of unilateral immediate breast reconstruction as it claims to have more aesthetic results and fewer surgical procedures.

KEYWORDS Breast Cancer, Mastectomy, Implant Based Reconstruction, Immediate Reconstruction

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Short Communication

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Post-mastectomy breast reconstruction can give more natural, feminine, attractive and balanced feel in terms of both looks and weight that appears normal in and out of cloths. This comes at the expense of long healing time, more time off from work and obviously, surgical scars. Furthermore, the chances of complications always remain there. Breast reconstruction can be done using autologous tissue or implants in a single stage or two stages. The primary goal of postmastectomy surgical management is to re-create symmetrical breast mounds. Implant based reconstruction can be one stage with the use of implant alone, or two-stage using tissue expander before replacement with a permanent implant. Many studies showed increasing trends of implant based reconstruction in comparison with autologous tissue reconstruction with a reported ratio of 2:1 to 9:1.¹⁻³ According to a survey, the rate of breast reconstruction with autologous tissue remained same from 1998 to 2008 while that of prosthetic reconstruction increased by 11%.¹ In 2016, 81% percent of breast reconstruction was by prosthetic method.⁴ Implant based reconstruction in the United States accounts for 65% of all breast reconstructions.⁵ The reason behind is multifactorial, including increased incidence of prophylactic contralateral mastectomy. Advantages of breast reconstruction with prosthetic technique include shorter operative time and hospital stay, fast recovery time and no need for donor tissue. Better symmetry and more attractive mound can be created with implant-based reconstruction and can help in patient's physio-psychological well-being. Nonetheless, there always remains risk of implant related complications like infection, implant migration or rupture

and capsular contracture. Also, prosthetic reconstruction lacks natural feel.⁶

Selecting a breast implant includes physical examination of the chest wall as this provides a foundation on which implant rests. Other measurements include breast base width, nipple to sternal notch distance on the normal side, nipple to inframammary fold distance on the contralateral side and inter-nipple distance. Breast base width is measured from the medial breast footprint to the anterior axillary fold. Tissue quality that will be left after mastectomy should be assessed along with upper pole fullness. Lowering of the inframammary fold and recruiting skin from the abdominal wall may be warranted. Placement of mastectomy scar in favorable position is included in preoperative marking.⁷ Among all, breast base width measurement is the most significant parameter for selection of implant in immediate breast reconstruction. Base width should match the base of implant to eliminate the dead space and redundancy of skin.⁸ Subcutaneous layer of 1 cm thickness and well vascularized skin flaps are consistently viewed as basic to accomplish effective results.⁹ Assessment by operating surgeon is considered the single most important influencing factor.^{10,11} Asymmetry is seen in one third of patient when implant was selected on all above mentioned parameters.¹² Assessment and prediction of breast volume is an underrated parameter and is challenging in single stage breast reconstruction. Water displacement method and cast made from thermoplastic material or gypsum may be used in case of delayed reconstruction.^{13,14} Weight of mastectomy tissue gives a wrong estimate of implant size and volume, due to weight and size of tumor itself.¹⁵

Different methods have been described in literature for assessment of breast volume, but still, no consensus has been made.¹⁶ Yan et al., in 2018, published their study on 115 breast reconstructions using implants in immediate setting. They estimated breast volume and implant size by mammography pre-operatively. They proposed, implant size can be estimated pre-operatively by using a formula, calculated implant size (ml) = $\pi \times \text{height (cm)} \times [\text{base width (cm)} - 3]$. They found, retrospectively, the mean calculated implant size was 376.03 ml, and the mean actual implant size used was 324.49 ml. They found no difference in calculated and actual implant size ($p=0.090$). They also concluded that more accuracy of the formula was seen in cases where less than 350 ml breast implant size was needed while there was a tendency of overestimation in cases of larger implant sizes. They found this formula to be an easy and accurate preoperative tool for calculation of implant size.¹⁷ Anthropometric measurements are also used to calculate breast volume. Qiao et al. proposed a formula for estimation of breast volume by using anthropometric measurements i.e. breast volume = $\pi/3 \times \text{MP}^2 \times (\text{MR} + \text{LR} + \text{IR} - \text{MP})$ where MP-mammary projection, MR-medial breast radius, LR-lateral breast radius, and IR-inferior breast radius.¹⁸ Kayar et al., compared results of different methods and found mammography is more accurate in calculation of breast volume than anthropometric measurements.¹⁹ Stefanie et al. used 3D imaging with the Microsoft Kinect sensor for the estimation of breast implant size and volume pre-operatively for unilateral breast reconstruction. They used Kinect II (Kinect for Xbox One, Microsoft) in ten patients to do so and found this technique to be fast, reliable and feasible though technically demanding.²⁰ Pawel et al. in 2014, compared preoperative anthropometric measurements, thermoplastic casting and optical method using 3D imaging by a 3D camera (analyzed by Antroposcan 3D program) for breast implant size selection in 50 patients of unilateral breast reconstruction. They found the highest accuracy in optical method for estimation of breast volume as compared to other two methods ($p<0.0001$). They concluded that the selection of breast implant using 3D scanning method is more precise than mostly used anthropometric and thermoplastic cast methods.²¹ Hyungsuk et al., in 2015, used magnetic resonance imaging (MRI), pre-operatively for assessment of implant volume and found mean implant volume was more close to the estimated volume of breast using MRI than measurement of mean weight of resected tissue intraoperatively ($p=0.001$).²²

Type of implant is also considered during selection. Different types of implants are available including saline vs silicone filled, smooth vs textured and round vs anatomical. Saline implants are easier to insert but have increased rates of rippling. Silicone implants have a better look and feel but have higher rates of capsular contracture and rupture, which is difficult to detect.²³ Higher patient satisfaction is seen with silicone implants.²⁴ Effort was made to reduce the capsular contracture by the introduction of textured implant in

replace of polyurethane coated prosthesis.²⁵ Macrotexture-plus, macrotexture, micro texture and nanotexture (smooth) implants are commercially available.²⁶ Salt crystal addition to silicon in different concentrations gives texture to implant by producing small pores of different sizes which have potential to adhere to surrounding tissues.²⁷ In 85-90% of cases, textured implants are used as compared to smooth implants that is mainly due to their low capsular contracture rates.²⁶ Occurrence of capsular contracture can be lowered by placing the implant behind the muscle.²⁵ Concern has been raised for development of breast implant associated anaplastic large cell lymphoma (BIA-ALCL). The incidence of its occurrence is very low i.e. 0.1 to 0.3 per 100000 implants-based breast surgery. Development of ALCL is more feared to develop with use of macro-textured implants.²⁸ Local inflammation due to texture of implant, silicon leak or formation of biofilm predispose patients to this condition.²⁹ In breast reconstruction, anatomical shaped implants are more preferred by surgeons as compared to round non-anatomical implants due to a better match for postmastectomy breast footprint. Furthermore, anatomical implants have better upper pole fullness and shape. Placement of shaped implants is technically demanding because it needs accurate pocket creation to prevent implant migration or rotation. Patients have reported firmer feel in comparison to round silicon-based implants.³⁰

Recently, use of acellular dermal matrix (ADM) is advocated in prosthetic breast reconstruction as it is claimed to provide support to both soft tissues as well as implant by better utilization and definition of mastectomy pocket. ADM gives good definition to lateral breast border and inframammary fold, prevents implant rotation or migration and also improves projection of lower pole.³¹ Rate of capsular contracture has seen to decrease to 0 to 4% with use of ADM as compared to previously reported rate of 10 to 30%.^{31,32} However, high incidence of complications have been reported with the use of ADM including seroma formation, infection, mastectomy flap necrosis and failure of prosthetic reconstruction.^{33,34} It is generally accepted that the benefits of ADM use out-weigh its possible disadvantages.

Other than breast footprint, soft tissue availability and type of implant, breast volume estimation is important in implant selection. Currently, work is being done on accurate volumetric measurement for breast implant selection pre-operatively. None of the described methods has been universally acknowledged. Further studies are required to achieve global acceptance. Furthermore, accurate volumetric assessment does not obviate the need of symmetry procedure on the contralateral breast but may prevent gross asymmetry and help achieve good aesthetic results after symmetrizing procedures like fat grafting, mastopexy, reduction or augmentation mammoplasty.

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Submission Declaration and Verification:

The authors verify that the work described has not been published previously, that it is not being considered for publication anywhere else, that its publication is approved

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