Immediate Breast Reconstruction

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FACULTY OF MEDICINE

INTEGRATED UNDERGRADUATE AND GRADUATE UNIVERSITY STUDY OF MEDICINE IN ENGLISH

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GRADUATION THESIS

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Abbreviations and Acronyms

ADM - Acellular Dermal Matrix
BCS - Breast-Conserving Surgery
DBR - Delayed Breast Reconstruction
DTI - Direct-To-Implant Breast Reconstruction
IBR - Immediate Brest Reconstruction
IBBR - Implant-Based Breast Reconstruction
NSM - Nipple-Sparing Mastectomy
PMRT - Post-Mastectomy Radiation Therapy
SSM - Skin-Sparing Mastectomy
TE - Tissue Expander
RAM - Rectus Abdominis Muscle
PMM - Pectoralis Major Muscle
BMI - Body Mass Index
TRAM - Transverse Rectus Abdominis Myocutaneous
DIEP - Deep Inferior Epigastric Artery Perforator
SIEA - Superficial Inferior Epigastric Artery
LDMF - Latissimus Dorsi Myocutaneous Flap
PAP - Profunda Artery Perforator
TUG - Transverse Upper Gracilis
DUG - Diagonal Upper Gracilis
VUG - Vertical Upper Gracilis
GM - Gracilis Muscle
SGAP - Superior Gluteal Artery Perforator Flap
IGAP - Inferior Gluteal Artery Perforator Flap
AFG - Autologous Fat Graft
FDFG - Free Dermal Fat Graft
AR - Autologous Reconstruction

1 Introduction

Breast cancer ranks among the most prevalent forms of cancer globally, with over 2.2 million women receiving a diagnosis in 2020 alone. Yet, when caught early, the treatment for breast cancer can be remarkably effective. Typically, it involves a synergistic approach of surgical removal, radiation therapy, and chemotherapy, which can mitigate the spread of the disease and improve patient outcomes. (1) Successful treatment often hinges on the surgical removal of the tumor, which can eliminate a substantial amount, if not all, of the cancerous tissue. This enhances the effectiveness of subsequent treatments, such as radiation or chemotherapy, and reduces the likelihood of disease recurrence. In the surgical management of breast cancer, two main approaches are commonly employed: mastectomy and breast-conserving surgery (BCS), also known as partial mastectomy, quadrantectomy, or lumpectomy. BCS is a surgical technique that focuses on eradicating cancerous tissue while concurrently aiming to preserve the breast architecture.

On the other hand, mastectomy represents a surgical approach that involves the excision of the entire breast structure, including all associated components, if necessary. (2) Although these surgical interventions are often life-saving, they can have substantial physical and psychological effects on patients, such as alterations to physical appearance, confidence, and overall quality of life. (3)

Breast reconstruction has become a valuable method to counteract the unpleasant effects of mastectomy, providing patients with the possibility of restoring their physical appearance and helping them to regain a sense of comfort in their bodies after surgery. Patients who have undergone a mastectomy have two primary options for breast reconstruction: immediate breast reconstruction (IBR; primary breast reconstruction) and delayed breast reconstruction (DBR; secondary breast reconstruction). (4) IBR is a surgical technique defined as any reconstruction carried out during the same operative procedure as the mastectomy. This approach can be beneficial as it reduces the need for additional surgeries, can improve the cosmetic outcome, and may result in a shorter overall treatment time. (5)

In contrast, DBR is typically performed after a healing period following the mastectomy to ensure optimal outcomes. This approach may be preferred when the patient requires postmastectomy radiation therapy (PMRT), which could negatively affect the reconstructed breast. DBR might also be chosen if a patient is uncertain about undergoing immediate reconstruction or needs more time to consider their options. (6)

Despite the unique benefits of both techniques, distinctive factors tailored to the patient still need to be addressed. These include determining the optimal timing of reconstruction, identifying patient selection criteria, and understanding long-term outcomes.

2 Aims and Objectives

This paper aims to provide a concise overview of immediate breast reconstruction with the objective of reviewing the different reconstruction techniques that can be used for this approach, such as implant-based reconstruction, autologous tissue reconstruction, and autologous fat grafting, as well as the benefits and drawbacks of immediate breast reconstruction for breast cancer patients.

3 Literature Review

IBR is a surgical procedure aiming to reconstruct the breast immediately after mastectomy, utilizing the same operative approach. Though numerous techniques are available for IBR, breast reconstruction is commonly achieved through one of three approaches. The first approach involves implants and skin expanders, the second utilizes flaps, also known as vascularized autologous tissue, and the third consists of autologous fat grafting. (5)
The subsequent sections will provide a concise overview of each approach, detailing their respective advantages and disadvantages.

3.1 Immediate Breast Reconstruction Using Implants and Skin Expanders

Breast Reconstruction Using Implants and Skin Expanders is a widely accepted surgical technique used to restore the appearance of the breast following mastectomy. This method has been shown to produce satisfying cosmetic outcomes with reasonable complication rates, provided that patient selection is carefully considered, making it a popular choice for many patients and surgeons. (7) Overall, the technique can be broadly categorized into two distinct approaches based on the number of surgical interventions required to attain the desired outcome. The first approach, known as the single/one-stage technique, involves immediate reconstruction with a permanent breast implant in a single operation. The second approach, the two-stage technique, involves placing a tissue expander in a newly created pocket directly after the mastectomy, followed by an exchange with an implant in a subsequent surgery months later. (8)

Additionally, Acellular Dermal Matrix (ADM) can be utilized during surgery as an additional method using a soft tissue graft to reinforce the surgical site, allowing improved outcomes after surgery. This is achieved by facilitating compliance during the expansion process while simultaneously ensuring complete and consistent coverage of the lower pole throughout the procedure. (9)

3.1.1 Immediate Single (One)-Stage Direct-To-Implant Breast Reconstruction

Performing a direct-to-implant (DTI) breast reconstruction in a single surgical stage can be an attractive option for patients facing a prophylactic or therapeutic mastectomy. (10) It enables simultaneous removal of the affected breast and placement of an implant in one procedure.
Still, not all patients are appropriate candidates for this approach, and the success of the surgery depends on careful consideration of patient selection and the surgeon's ability to make informed intraoperative decisions. (11)
The most suitable candidates for DTI reconstruction are healthy, nonsmoking individuals with minor to moderate breasts who aim to achieve a similar size following surgery and don't desire significant augmentation. Patients who have undergone prior breast radiation or have existing scars that negatively affect the blood supply to the skin flaps are not ideal candidates due to higher complication rates and the possibility of contractures. Patients with specific comorbidities such as severe obesity, uncontrolled diabetes, thin or poorly perfused mastectomy skin flaps, or advanced cancer may benefit from a two-stage approach. Conversely, DTI may be more suitable for older or medically compromised patients who cannot endure multiple procedures or prefer to avoid multi-stage surgery. But the ultimate decision regarding the feasibility of DTI is typically established during the operation, based on the perfusion status of the mastectomy skin flap.
The procedure commences with the mastectomy of the general surgeon, who also contributes to the preoperative planning. To ensure careful treatment of the skin and avoid unnecessary tissue retraction, it is advisable for the plastic surgeon accountable for the subsequent reconstruction to assist in the preceding intervention. This way, they can guarantee meticulous tissue handling and establish the optimal foundation for the subsequent reconstruction. (12)
Before undergoing DTI, the mastectomy is typically performed using skin-sparing or nipple-sparing techniques (SSM, NSM), depending on whether the excised tissue samples beneath the nipple and areola exhibit signs of cancer infiltration and perfusion status, thus allowing their preservation. SSM and NSM aim to remove breast tissue while preserving as much skin as possible, as well as the nipple and areola, if possible, to be utilized afterward.

In most cases, lymph nodes are removed to assess the presence of cancerous spread outside the breast unless the mastectomy is purely prophylactic. The specific type of lymph node dissection, whether sentinel or axillary, depends on the diagnosis. (13)

If the patient meets the necessary criteria, immediate single-stage DTI can be initiated following the SSM or NSM. It offers two options for implant placement: subpectoral reconstruction, where the implant is positioned beneath the pectoralis major muscle (PMM), or prepectoral reconstruction, where the implant is placed above the muscle. (14)

In the case of subpectoral reconstruction, the initial step involves attempting to prepare a combined muscle flap along the submammary fold. Careful handling is employed to preserve sufficient flap length for extensive implant coverage without compromising tissue elasticity, ensuring good hemostasis. The flap primarily consists of the PMM, with smaller contributions from the M. serratus anterior, M. obliquus externus abdominis, M. rectus abdominis, and intermuscular connective tissue fibers of the thoracic wall to create a stable and supportive pocket for the implant.

When selecting the implant, careful consideration is given to the individual anatomical characteristics of the patient. Avoiding excessive tension after placement by choosing an appropriately sized implant to prevent future wound healing issues and postoperative complications is essential. To prevent the muscle flap from shifting upwards and sliding over the implant, securing it in the breast fold is necessary, which can be achieved using sutures, ADM, or meshes for fixation. Avoiding skin closure directly over the visible implant promotes optimal wound healing and minimizes the risk of implant-related infections. In cases where this is impossible, a procedural adjustment, such as utilizing a tissue expander, may become necessary.

After the reconstruction, employing postoperative drainage of the surgical site and administering infection prophylaxis is recommended. Additionally, the transcutaneous sutures used to secure the muscle should be carefully removed after approximately one week. This facilitates proper adhesion of the muscle flap to the surrounding skin. (15)

In contrast, the prepectoral approach involves placing the implant directly on top of the PMM, leaving it intact, and preserving the natural movement of the chest, to create a pocket utilizing the skin flaps into which the implant can be inserted.

This technique offers several advantages, including a quicker and less invasive procedure, resulting in a shorter recovery period. Furthermore, since the muscles are not affected, there is a reduced risk of implant migration and animation deformities caused by muscle contractions.

The condition of the preserved skin after the oncologic resection plays a vital role in the procedure's success because compromised blood circulation can give rise to complications such as skin necrosis, increased infection risks, and other potential challenges. Moreover, insufficient skin thickness may lead to visible rippling, palpability, and malposition. Hence, it is crucial to conduct a thorough evaluation and consider these factors when determining the suitability of this technique to achieve optimal outcomes. (16)

However, significant advancements have been made to counteract these challenges in recent years. As a result, the prepectoral position, incorporating the use of ADM, robust and cohesive gel implants, and autologous fat grafts (AFG), has emerged as a promising and safe alternative to the dual-plane approach. (17)

The implant selection is based on various factors, such as the quality of the breast tissue and the patient's preferences. To ensure the correct proportions, a sizer can be initially used to determine the most suitable option to provide a natural and aesthetically pleasing result. Subsequently, the chosen implant can be enveloped with ADM on both sides to minimize the risk of postoperative complications in the future. This technique also provides the opportunity to secure the implant to the underlying muscle and skin flap using absorbable fixation sutures, reducing the likelihood of implant migration due to the stable support.

The incision is carefully closed after inserting the implant to promote proper wound healing. Drainages may also be employed to prevent fluid accumulation in the surgical area. Postoperative infection prophylaxis and negative pressure wound therapy are recommended to minimize the risk of complications. (18)

3.1.2 Immediate Two-Stage Tissue Expander and Implant Breast Reconstruction

Radovan's introduction of tissue expanders revolutionized the field of IBR, leading to a shift in the preferred approach from single-stage reconstructions with implants to adopting two-stage reconstructions during the 1980s. As a result, two-stage reconstruction has become the most practiced method of implant-based breast reconstruction in contemporary practice.

This method involves a two-step process, starting with the submuscular placement of a deflated tissue expander (TE) immediately after the mastectomy during the same surgical procedure. Over several months, the TE is moderately filled with saline solution to carefully expand the breast and muscle tissue and promote wound healing.

Textured expanders were introduced as a substitute for smooth-surfaced expanders used in the past to minimize issues like capsular contracture, ensure more stability, and help maintain the proper positioning throughout the breast reconstruction process. Its gradual inflation creates a

spacious pocket that can ultimately accommodate the permanent implant, which matches the size and shape of the patient's natural breast and is placed in a second surgical procedure. (19) Unlike the single-stage DTI, this approach involves opening the submuscular pocket along the fibers of the pectoralis major muscle (PMM) at the position of the fourth and fifth ribs. The goal is to create a well-defined space extending ca. 1-2cm beneath the submammary fold, providing complete muscular coverage over the expander prosthesis when inflated.

The selection of the most suitable type of expander implant depends on the patient's individual needs. However, it is common to use volumes of approximately 600cc. Multiple options are available on the market, including single-chamber or dual-chamber systems, with integrated or remote port valves. Integrated valves offer the advantage of not bearing the risk of rotation and not requiring an additional pocket for the valve. However, there is a potential danger of mispuncture leading to perforation when using an integrated valve. Choosing an implant with a textured surface promotes tissue adherence and prevents displacement during the filling process, and careful attention should be given to the lateral part when preparing the muscle flap, as this can quickly tear due to its thin consistency. The non-pre-filled TE prosthesis is carefully placed in the prepared submuscular position, and after the closure of the muscle incision, it can be filled with a saline solution ranging from 100-200cc. It is important to avoid excessive tension on the muscle layer during this process. The skin closure should be supported by well-vascularized muscle tissue at the wound site. The use of drainage in both wound cavities is recommended, and the administration of peri- and postoperative antibiotic prophylaxis is essential. (15)

This biphasic approach allows for careful control of the reconstruction process, enabling surgeons to optimize the aesthetic outcomes and ensure adequate healing and tissue viability. It is suitable for patients who require more significant breast reconstruction or have insufficient breast tissue and skin elasticity and therefore do not qualify for a single-stage DTI. Immediate TE and implant-based breast reconstruction can be a suitable surgical option for patients undergoing PMRT. While irradiation to the TE can pose challenges and increase the risk of complications, these patients still have an acceptable rate of capsular contracture compared to other implant-based radiotherapy approaches and lower revision rates in irradiated breasts, which suggests that immediate TE and implant breast reconstruction can be considered a reasonable choice for patients receiving PMRT. (20)

Also, it is more suitable for individuals seeking a substantial increase in breast size and patients with conditions such as severe obesity, compromised blood flow, uncontrolled diabetes, or advanced cancer.

Disadvantages of this procedure include that patients must undergo repeated visits to the doctor's office due to the systematic expansion process and subsequently undergo another surgical intervention for the exchange with the final implant. This comprises additional risks, potential side effects, and an extended recovery period. This aspect can pose significant challenges, especially for older or medically compromised patients who may not have the same level of flexibility and resilience as healthy ones.

It is, therefore, essential to carefully consider each patient's individual circumstances and needs to make the best possible decision regarding whether a TE is preferable to a DTI reconstruction. Currently, also air-filling TE are alternatively available, presenting a novel approach. These expanders can be conveniently inflated at home periodically, thereby eliminating the need for frequent visits to medical professionals. However, it is imperative to emphasize the significance of optimal patient compliance to attain the desired outcome successfully. (21)

Postoperative planning involves monitoring the patient for complications like infection, seroma, or implant malposition. Regular follow-up appointments are necessary to monitor the healing process and ensure the final implant is appropriately positioned and sized. More possible complications associated with this approach, which need to be checked for, include implant rupture, leakage, and capsular contracture. However, with careful patient selection and proper surgical execution, the outcome of IBR using TE and implants can be favorable, with high patient satisfaction rates. (12)

3.2 Immediate Breast Reconstruction Using Autologous Tissue.

Breast reconstruction utilizing vascularized autologous tissue flaps involves the transfer of the patient's tissue from one area of the body, for example, the abdomen or the back, to the chest to reconstruct the breast with or without the additional involvement of an implant at the same time of the mastectomy, therefore being a valuable option for IBR. (22)

The harvested tissue is typically reconnected to the blood supply and, thus, requires microsurgical techniques to provide the optimal chance to ensure tissue viability and restore sensory abilities. Autologous tissue reconstruction offers a more natural-looking and feeling breast and may be preferred by patients who want to avoid using implants. But it is a more invasive procedure involving a longer recovery time and adding a higher risk for complications due to multiple interventions at different body parts, including pain, weakness, or the development of hernias. To minimize such difficulties, it is imperative to

carefully select suitable patients and diligently preserve both muscle tissue and fascia during the procedure.

Thanks to remarkable advancements and innovations in imaging, plastic surgeons can now utilize alternative flaps from several areas of the human body, such as the thigh, posterior trunk, and gluteal region, in addition to the commonly used abdominal-based grafts. This enables them to identify perforators accurately and strategically plan to use different flaps based on individual patient needs. Yet, flaps sourced from the posterior trunk and gluteal region can cause unpleasing scars, limited flap dimensions, and challenges regarding the adipose tissue. (23)

3.2.1 Abdominal-Based Flaps

The method of abdominal-based flaps becomes valuable when there is too little breast tissue and skin remaining to adequately form a new breast mound or cover and support a breast implant, particularly following a mastectomy or radiation treatment. It is the most prevalent tissue reconstruction technique, utilizing the skin and adipose tissue from the lower abdomen to sculpt a natural-looking breast contour. Following the surgery, patients will have a discreet horizontal scar in the lower abdomen, easily covered by undergarments and swimwear, making it not visible at first sight.

However, there are situations where women may not qualify for abdominal-based flaps due to underlying conditions like insufficient donor tissue in the area, previous scars that may have affected critical blood vessels, or previous unsuccessful flap procedures prompting the search for alternative options like back, thigh, or gluteal-based techniques.

Abdominal-based flaps can be classified into various subtypes, each distinguished by the specific blood vessels that nourish them. They encompass the Pedicled TRAM (transverse rectus abdominis myocutaneous) flap, the free TRAM flap, the SIEA (superficial inferior epigastric artery) flap, and lastly, the DIEP (deep inferior epigastric artery perforator) flap upon which I will provide a brief overview in the following passages. (21)

3.2.1.1 Pedicled TRAM Flap

Introduced by Hartrampf in 1982, the pedicled Transverse Rectus Abdominis Myocutaneous (TRAM) flap technique has emerged as the prevailing approach for autologous tissue reconstruction. This method involves the transfer of skin and adipose tissue from the lower

abdomen, utilizing the ipsilateral or bilateral rectus abdominis muscle as a conduit to ensure an adequate blood supply from the superior epigastric vessels.

The initial incisions during the procedure must be well-planned to allow for a tension-free closure at the donor site postoperatively. The dissection of the abdominal flap extends up to the costal margin, followed by careful elevation from the posterior rectus sheath. Eventually, the flap, comprising the muscle and anterior sheath, is divided at its lower end. A subcutaneous tunnel is carefully formed to aid the transposition of the abdominal flap to the breast region, reaching the inframammary fold. This tunnel serves as a pathway through which the flap is carefully maneuvered towards the breast and firmly attached to the chest wall using sutures. After this step, the flap is appropriately contoured, excessive tissue is excised, and any abdominal wall skin concealed beneath the mastectomy flaps is de-epithelialized. Lastly, the abdominal fascia is repaired utilizing a prosthetic mesh to ensure proper structural support. (24)

Suitable patients for pedicled TRAM flap reconstruction should have sufficient abdominal tissue to form a natural-looking breast. A healthy and robust rectus abdominis muscle is also crucial, as it is used as the pedicle (vascular supply) to transfer the tissue to the chest. This technique is particularly beneficial for patients with smaller to moderate-sized breasts, as it provides a good amount of tissue for reconstruction. Moreover, candidates should be in overall good health and free from any underlying medical conditions that may increase the risks associated with surgery. They should have realistic expectations about the outcomes and understand the potential limitations of the procedure. Commitment to the recovery process is essential, as pedicled TRAM flap reconstruction involves a longer surgical procedure and a prolonged hospitalization than other breast reconstruction methods. (25)

3.2.1.2 Free TRAM Flap

Like the pedicled TRAM flap, the free TRAM flap exploits the vascularity provided by the blood vessels traversing the rectus abdominis muscle (RAM). Yet, in the context of the free TRAM flap procedure, an incision is made in the lower abdomen, typically in the shape of a transverse ellipse, to expose the RAM, which is carefully dissected along with its blood supply, known as the inferior epigastric vessels, creating a muscle flap with a vascular supply. The muscle flap, superjacent skin, and fat are precisely detached from the abdomen while preserving perfusion and then repositioned to the mastectomy site. To ensure successful reperfusion, intricate microscopic anastomosis techniques are employed to establish vascular

connections between the blood vessels originating from the muscle and those residing within the chest cavity as recipients. (21)

In contrast, as described earlier, the pedicled TRAM flap technique utilizes almost the entire ipsilateral side of the RAM, a prominent part of the abdominal musculature. Conversely, the free TRAM flap approach involves the selective harvest of a partial RAM segment while preserving its vascularity by utilizing the inferior epigastric vessels. This surgical modification contributes potential benefits for keeping abdominal strength and stability postoperatively. (22) (26) Hence, this approach is commonly referred to as a muscle-sparing technique in literature, as it exhibits the possibility of reducing abdominal morbidity.

Schwitzer et al. have indicated that individuals who chose pedicled TRAM flap reconstruction initially expressed greater happiness regarding the aesthetic outcome of their breasts than those who received free abdominal TRAM flap reconstruction. Nonetheless, satisfaction levels converged over time between the two reconstruction approaches, implying that long-term gratification may be analogous irrespective of the selected technique. (27)

Patient selection criteria for the free TRAM flap technique resemble those employed for the pedicled TRAM flap, necessitating a comprehensive evaluation of abdominal suitability, overall health status, smoking habits, and body mass index (BMI) to make patients eligible. Sufficient lower abdominal tissue and a robust RAM are essential for favorable flap formation outcomes. Patients must exhibit good health and be bare of medical conditions that could impede wound healing or escalate surgical risks. It is crucial to note that smoking adversely affects the procedure's success, and patients are typically advised to cease smoking before surgery. (25)

In summary, the critical distinction between a free TRAM flap and a pedicled TRAM flap lies in the vascular supply to the transplanted tissue and the extent of RAM employed. In the free TRAM flap procedure, microsurgical techniques are utilized to reconnect the flap's blood vessels to those of the recipient, allowing for enhanced flexibility in positioning and shaping the flap, as it is not constrained by the need to preserve a tissue pedicle. This approach offers the advantage of precise vessel-to-vessel anastomosis, leading to improved blood perfusion in the reconstructed breast.

Conversely, in pedicled TRAM flap breast reconstruction, the RAM and its vascular supply remain connected to the donor site through a tissue pedicle. The flap's blood circulation is sustained through this pedicle. While the pedicled TRAM flap technique eliminates the requirement for microvascular anastomosis, it presents limitations in flap positioning and shaping due to the fixed nature of the pedicle.

By selectively harvesting a partial segment of the RAM in the free TRAM flap, a more significant portion remains intact, potentially leading to better preservation of muscular strength and function. This can positively affect physical resilience and the ability to perform everyday activities, influencing the quality of life.
The selection of the optimal method depends on various factors, including the patient's anatomical considerations, the surgeon's preference, and the accessibility to microsurgical expertise.

3.2.1.3 DIEP Flap

Deep Inferior Epigastric Perforator (DIEP) flap breast reconstruction is a surgical technique that involves the extraction of blood vessels known as deep inferior epigastric perforators, along with the encompassing skin and adipose tissue from the lower abdomen, for breast reconstruction. Notably, this procedure leaves the underlying RAM intact, preserving its structural and functional integrity. (28) Therefore, the DIEP flap technique differentiates itself from the TRAM flap approaches by not requiring the utilization of muscle tissue. In a DIEP flap procedure, subcutaneous adipose tissue, skin, and the accompanying vascular network are harvested from the lower abdominal region and transplanted to the chest for breast reconstruction. The surgeon performs microsurgical anastomosis, reconnecting the blood vessels of the DIEP flap to those in the breast region with precision and expertise.
As the procedure does not involve using muscle tissue, most patients undergoing DIEP flap reconstruction typically experience faster postoperative recovery. Furthermore, this approach offers the added advantage of mitigating the risk of compromising abdominal strength, a potential concern associated with various TRAM flap techniques. Due to the complex nature of the DIEP flap procedure, its successful execution necessitates specialized surgical training and proficiency in microsurgery. Consequently, not all surgeons possess the requisite skills to perform DIEP flap reconstruction, and the availability of this technique may be limited to select medical centers or hospitals where the necessary expertise is present.
This technique is associated with developing a long horizontal scar spanning from the lateral aspect of one hipbone to the corresponding counterpart on the opposite side. In most cases, the resulting abdominal scar is strategically situated below the infrapubic crease, commonly referred to as the bikini line, thereby facilitating its concealment within the boundaries of swimwear or undergarments. Following the excision of the donor tissue from the abdominal

region, the area is closed without necessitating the utilization of mesh material, which may be required in certain instances of TRAM flap procedures for additional support. (29)

The patient selection process for this technique shares similarities with the previously discussed TRAM techniques. Nonetheless, this flap technique is commonly favored due to its superior cosmetic outcomes, long-term durability, and high patient satisfaction. These advantages extend to high-risk individuals, further establishing the DIEP flap as a preferred option in such cases. (23) Prantl et al. provided evidence suggesting that immediate DIEP flap reconstruction does not pose a higher risk of complications or adverse effects on flap outcomes when compared to a delayed approach. These findings align with the current tendency of growing utilization of IBR. Moreover, in the context of profit-making pressures in healthcare, the substantial reduction in hospitalization associated with IBR should be acknowledged and valued. (30)

3.2.1.4 SIEA Flap

The SIEA flap is an advancement in autologous breast reconstruction, building upon the principles of the DIEP flap technique and sharing similarities. However, there is a notable distinction in the choice of blood vessels harvested from the abdominal region along with the skin and adipose tissue. It exploits the presence of the superficial inferior epigastric artery (SIEA), a blood vessel that courses above the RAM and plays a crucial role in supplying blood to the overlying skin and adipose tissue utilized in the reconstruction process.

Unlike the DIEP flap, which necessitates an incision in the fascia covering the RAM, the SIEA flap eliminates the need for this specific incision, making it a muscle-sparing technique easier to recover. Unfortunately, the eligibility for an SIEA flap reconstruction is limited for most women due to several distinct factors. For instance, the superficial blood vessels typically exhibit inadequate size to sustain the flap adequately, or they may have been disrupted during a prior surgical procedure such as a C-section or hysterectomy, or in some cases, these vessels may be absent altogether.

Before the surgical intervention, a comprehensive evaluation of the blood vessel anatomy is often conducted through a CT angiogram, particularly when considering the implementation of a DIEP or SIEA flap. This assessment becomes particularly critical in cases where patients have a history of previous abdominal surgery, as it may contraindicate the feasibility of such procedures. However, even with the identification of suitable blood vessels through the CT scan, it does not guarantee the implementation of an SIEA flap. The optimal flap technique is selected intraoperatively, considering factors such as the quality of identified vessels and

other relevant aspects. In situations where the viability of an SIEA flap is compromised, the utilization of A DIEP flap or one of the TRAM flap techniques can be considered an alternative option.

The SIEA flap offers a notable advantage of minimal abdominal wall weakness, the least among procedures utilizing abdominal wall tissues. However, it is essential to acknowledge certain disadvantages associated with this technique. Firstly, the presence or adequacy of the required anatomy may be lacking. Additionally, the SIEA flap tends to result in smaller breast size and a higher incidence of blood flow complications, along with some other technical limitations. (31) (32)

In summary, the SIEA flap offers a significant advantage by eliminating the need for mobilizing the RAM or anterior fascia, thereby reducing the technical complexity associated with TRAM or DIEP flaps. However, a notable limitation of the SIEA flap lies in the variable vascular anatomy, presenting a challenge. Approximately 70% of cases are contraindicated for this flap technique due to the absence or inadequacy of an arterial pedicle. (33) Grünherz et al. reported that its clinical use represents a viable and reasonable choice for autologous breast reconstruction, offering the benefit of minimal morbidity at the donor site. However, they emphasize the importance of selective application, specifically in cases with favorable anatomical characteristics. Therefore, they recommend a thorough patient selection process, incorporating CT angiography before the operation, clinical assessment during the procedure, and consideration of the patient's history of hypercoagulable conditions. (34)

3.2.2 Trunk-Based Flaps

In cases where abdominal-based flap techniques are unsuitable or inaccessible, it is essential to recognize other possible regions for flaps as alternative options. Using truncal flaps is a viable choice for autologous breast reconstruction, demonstrating similar perioperative and long-term results. (35)

3.2.2.1 Latissimus Dorsi Myocutaneous Flap (LDMF)

The Latissimus Dorsi Myocutaneous Flap (LDMF) is a well-known and safe option among the available autologous tissues for breast reconstruction, owing to its good aesthetic outcomes and well-documented anatomical characteristics. LDMF can be combined safely with or without implants to improve cosmetic outcomes immediately after the mastectomy.

The effectiveness of this approach is based on surgical proficiency and postoperative management, resulting in a well-defined breast contour, an aesthetically acceptable scar, and desirable symmetry. These outcomes emphasize the value of this technique for IBR. (36)

As the name implies, LDMF involves the utilization of the large latissimus dorsi, a robust and vascular muscle located on the posterior trunk, which is predominantly supplied by the axillary artery. It is called a muscle-transfer flap type due to its substantial muscular component. Therefore, patients may experience a potential decline in strength or functionality due to muscle utilization, which can impede daily activities, and specific movements in sports. Therefore, bilateral reconstruction is generally not recommended, as it may lead to muscle-related complications on both sides. (37)

The LDMF is suitable for patients with limited abdominal donor material for abdominal-based flaps due to factors such as low body weight or complications that render other methods unsuitable. It is classified as a pedicled flap, as it involves the release of the muscle while preserving its integrity and utilizing it as a source of the vascular supply, which is then redirected to the breast region through a tunnel created below the axilla, serving as a source of new tissue for the reconstruction process. (21)

Its advantage lies in the high safety factor attributed to the excellent blood circulation associated with the procedure, making it a suitable option even for older or smoking patients. This technique is particularly effective for skin replacement and coverage for breast implants, making it valuable for a wide range of cases. The elongated pedicle of the latissimus dorsi muscle provides excellent flexibility during the reconstruction process, while the stability of the results is known to be long-lasting.

However, it is essential also to consider disadvantages, like the limited availability of autologous tissue for the procedure. While the results are highly predictable, the autologous tissue used in this technique may have restricted malleability in shaping. In some cases, achieving symmetry may require additional breast implants, leading to a combined reconstruction approach. Furthermore, the quality of the reconstructed skin may differ from the native breast tissue. It is also worth noting that, although infrequently, muscle activities such as muscle pull or twitching may occur postoperatively.

There are several contraindications to consider when evaluating the suitability of a latissimus dorsi reconstruction procedure. These include the presence of extensive scar tissue in the donor area, a history of thoracotomy in the latissimus region, previous transection of the supplying vessels in the thoracodorsal region, generalized vascular disorders, and the involvement of an inexperienced surgeon. It is crucial for a qualified surgeon to carefully

assess these factors above to determine the appropriateness of an LDMF reconstruction for each case to achieve the optimal patient outcome. (38)

3.2.3 Thigh-Based Flaps

Thigh-based flaps can be an alternative for patients ineligible for the aforementioned flap-based reconstruction techniques or who favor avoiding a long horizontal scar on the lower abdomen. These flaps offer the advantage of being less conspicuous at first glance, ensuring satisfactory aesthetic outcomes. (39)

The direction of the contributing incision on the upper inner thigh serves as a subclassification of thigh-based flaps into the TUG flap (Transverse Upper Gracilis flap), the VUG flap (Vertical Upper Gracilis flap), and the DUG flap (Diagonal Upper Gracilis flap). They all share that they are constructed with the Gracilis muscle (GM).

In addition, muscle-sparing thigh-based flaps are also possible by utilizing the Profunda Artery as Perforator. Therefore, they are called PAP flaps, having the advantage of not sacrificing any muscle tissue and an effectively concealed scar within the buttock crease. (21)

3.2.3.1 TUG/VUG/DUG Flaps

The TUG, VUG, and DUG flaps are surgical techniques that involve the utilization of the GM, a small yet versatile muscle located in the upper thigh region. These flaps entail careful dissection, mobilization, and surrounding tissues comprising fat and skin. The selection of the GM is based on its dependable blood supply, facilitating successful transplantation and revascularization at the recipient site. Despite the muscle dissection, patients generally do not experience significant functional impairment or noticeable loss, as the remaining muscles in the thigh region can compensate for its absence (36). Removing a horizontally aligned ellipse down the medial thigh ensures the acquisition of an adequate amount of donor tissue for the reconstruction process. Careful preservation of the medial circumflex artery and venae comitantes guarantees good perfusion of the transferred tissue.

Patients with abundant fatty tissue and surplus skin with higher BMI can benefit from the availability of extensive donor tissue, allowing for comprehensive reconstruction and improved aesthetics. Additionally, the flaps feature a reliable and easily harvested vascular pedicle, minimizing complications and simplifying the surgical procedure. The harvesting

process can provide a cosmetic advantage by tightening the upper inner thigh skin, resembling a thigh lift, and enhancing the overall contour.

While these flaps present numerous benefits and a suggested low incidence of complications at the donor site, specific limitations have been observed in their utilization. Notable limitations include the potential risk of compromising lymphatic drainage in the leg, occasional restrictions in the availability of adipose tissue and skin, the tendency for the donor site closure scar to widen and descend over time, and the relatively limited length of the vascular pedicle. (40)

3.2.3.2 PAP Flap

The Profunda Artery Perforator (PAP) flap represents a promising substitute in breast reconstruction, particularly in cases where an abdominal-based flap is not feasible or contraindicated. This surgical approach is particularly well-suited for patients with an average body weight who encounter challenges due to insufficient abdominal tissue availability yet aspire to achieve symmetrical and aesthetically pleasing outcomes in restoring their more prominent breasts. Gracilis-based flaps are not ideal in such cases due to their limited volume production and short pedicle length. Therefore, considering the PAP flap becomes relevant, as it offers a longer pedicle length and the ability to create a larger flap, enabling the reconstruction of a more extensive breast, even in patients with a normal BMI and leaner physique.

In the PAP flap procedure, the skin is incised in an elliptical shape approximately 1cm below the gluteal fold, extending up to 8cm distally. This allows for extracting a large flap and concealing the surgical scar within the gluteal fold, minimizing its visibility. Subsequently, while preserving the GM, the surgeon carefully identifies and dissects the Profunda Artery Perforator to later connect the flap to the blood supply in the breast through microsurgery and suitable anastomoses.

After a successful harvest, the weight of the newly acquired flap is compared to the weight of the total tissue removed during the mastectomy to ensure enough material for reconstruction. If the flap weight is insufficient, which can occur, the same technique can be applied to the other leg to create an additional PAP flap, which can be added to achieve the desired volume for a symmetrical breast. When multiple flaps are required, this approach is called stacked flaps. The surgeon can ensure proportional breast size with sufficient donor material, resulting in patient satisfaction postoperatively.

Like other thigh-based flaps, the cosmetic outcome of the PAP flap is favorable due to its effect resembling a thigh lift and the advantage of better concealing the surgical scar.
In summary, this innovative method is a great choice for breast reconstruction, particularly for thinner patients having larger breasts, yielding positive results. One of the drawbacks of this method is the potential occurrence of wound dehiscence on rare occasions. Therefore, careful patient selection and preparation, as well as the surgeon's experience and postoperative care, are essential factors in optimizing the procedure. (41)

3.2.4 Gluteal-Based Flaps

The utilization of buttock tissue in breast reconstruction is also employed for patients lacking sufficient abdominal tissue, experiencing limitations due to previous surgeries, or expressing a preference against breast implants. However, the firm characteristics of the skin and fatty tissue from this location frequently limit the amount of viable tissue that can be obtained for transplantation.
The flap harvested from this area consists of the skin, adipose tissue, and vascular supply from beneath. Depending on tissue availability, there are two potential donor sites: the upper buttock section, supplied by the superior gluteal artery and vein, or the lower section, supplied by the inferior gluteal artery and vein. Detached from their original blood supply, these flaps are subsequently reconnected to the blood vessels in the breast area, classifying them as free flaps. The specific names assigned to these flaps are the Superior Gluteal Artery Perforator Flap (SGAP) for the upper area and the Inferior Gluteal Artery Perforator Flap (IGAP) for the lower area.
Gluteal-based flaps offer several advantages. It allows for muscle preservation, which helps to maintain the buttock region's functional integrity. Patients may also experience reduced postoperative pain compared to procedures involving muscle sacrifice. However, there are certain disadvantages associated with the use of this approach. One major drawback is the technical complexity of the process and the time it consumes. It requires the specialized skills and experience of the surgeon to ensure optimal outcomes. Furthermore, utilizing buttock tissue may sometimes necessitate multiple surgeries, particularly in cases of bilateral reconstruction. This can prolong the treatment duration and increase the overall burden on the patient. The surgeon and the patient must consider this aspect when planning the surgical schedule. Moreover, removing tissue from the buttock region may give rise to a noticeable depression or a mild to moderate extent dip at the donor site. While efforts can be made to minimize the visibility of this depression through careful surgical techniques, it is still

important to align expectations accordingly. Finally, scarring on the buttock is an inevitable outcome of the procedure. As with any surgical intervention, patients should be aware of the potential for scarring and provided with appropriate counseling on scar management.

Considering these advantages and disadvantages is crucial for healthcare professionals when evaluating buttock tissue as a reconstructive option. A comprehensive discussion with patients, considering their circumstances and preferences, can help guide the decision-making process and ensure realistic expectations regarding the outcomes of buttock-based breast reconstruction. (42)

3.3 Autologous Fat Grafting

Currently, breast reconstruction immediately following mastectomy predominantly involves flap-based or implant-based procedures. Autologous fat grafting (AFG), commonly employed in breast-conserving surgery, has emerged as an adjunct technique in IBR. Furthermore, AFG has gained recognition as a standalone approach for IBR after radical mastectomy, demonstrating high safety and consistently favorable outcomes, even in patients necessitating radiation therapy. (43)

BCS may not consistently deliver satisfactory results, especially in complex cases involving more extensive tumors, minor-size breasts, or tumors positioned at the connection of the upper and inner quadrants. This innovative approach utilizes the patient's adipose tissue to address the concerns of volume, shape, and symmetry. The procedure encompasses precise defect measurement and the elliptical extraction of a Free Dermal Fat Graft (FDFG) from the lower abdomen. The harvested FDFG is carefully tailored to match the desired contour and strategically inserted into the breast, promoting revascularization with the surrounding tissues. By harnessing the potential of autologous tissue, immediate AFG offers a natural and harmonious outcome, eliminating the necessity for synthetic implants or extensive flap mobilization and leading to faster recovery. It provides a simple, effective, and comparatively low-risk method for achieving good aesthetic results. Furthermore, it minimizes the potential long-term repercussions of PMRT on the breast and skin. With its ability to address complex defects and high patient satisfaction rates, immediate AFG represents a notable advancement in breast reconstruction after BCS. (44)

4 Discussion.

The surgical technique of IBR has gained significant acceptance among surgeons and patients in recent years, emerging as the preferred method over delayed reconstruction. Notably, in the United States alone, approximately 70% of breast reconstructions are conducted simultaneously with cancer operations. Consequently, it becomes evident that IBR offers compelling advantages to have achieved such popularity. A key advantage lies in the fact that patients only require a single surgical procedure to attain their final outcome, as opposed to the minimum of two surgeries involved in delayed reconstruction. This translates to higher costs and more extended hospital stays, which can be burdensome for working individuals or single parents until they can reintegrate into their daily routines. Moreover, multiple surgeries impose recurring psychological distress on patients, prolonging their confrontation with this issue. Additionally, it is worth mentioning that patients undergoing delayed reconstruction live with an unreconstructed breast for months, potentially leading to self-worth issues and prolonged discomfort within their bodies. In contrast, IBR addresses these concerns in a single operation.

Nonetheless, immediate reconstruction may not be appropriate for every patient, specifically those with significant comorbidities, as the technique may impose excessive stress on the body and, therefore, may be better divided into two surgeries. This consideration applies to older patients as well. It is also not recommended for patients requiring PMRT, as it may negatively impact the outcome, making it more favorable to pursue reconstruction after completing the radiation therapy. It is known that approximately half of the women who undergo radiation therapy following IBR require revision of the reconstruction through a second surgery. (45)

A multitude of factors, encompassing preferences, resource accessibility, and surgical suitability, influences the patient's choice between implant-based and autologous reconstruction. Nevertheless, although there are no apparent overall disparities in psychosocial and physical well-being between immediate implant-based reconstruction and autologous reconstruction (AR), it is worth noting that women who opt for AR may encounter potential morbidity associated with flap grafting, mainly when performed bilaterally. The incidence of breast seroma is potentially higher in implant-based breast reconstruction compared to AR, mainly when ADM is utilized. However, there is inadequate evidence concerning most surgical complications in this context. Autologous breast reconstructions have a higher incidence rate of thromboembolic events, which is associated with the prolonged duration of the operative procedure, and elevates the chance for deep vein

thrombosis as well as pulmonary embolism. However, it can be stated that AR yields advancements in sexual comfort and better aesthetic results, and it is associated with more outstanding long-term durability, as patients are less prone to experiencing reconstructive failure compared to implant-based breast reconstruction. (46)

An essential advantage of immediate implant-based reconstruction, which attracts many women to choose this method, is the faster recovery time and shorter surgical procedure. Furthermore, there is no need for an additional intervention in another area of the body to obtain donor material, eliminating the associated complications, risks, and the formation of other scars. However, it should be noted that implants, being non-biological materials, may not provide the same natural appearance and texture as AR. Autologous flap reconstruction allows for natural changes in breast size and shape in response to weight fluctuations, which is impossible with implant-based reconstruction. Moreover, DIEP flap reconstruction, utilizing abdominal tissue, provides the additional advantage of achieving a flatter abdomen, comparable to the results obtained from a standard tummy tuck procedure. While implant-based reconstructions may have shorter initial surgery and recovery times, it often necessitates frequent office visits for tissue expansion in cases where expanders are used. In addition, it is worth noting that implants may require periodic removal or replacement, which is generally not encountered in AR. Furthermore, it is essential to consider that women who choose implant-based reconstruction often undergo surgical modifications on their unaffected breast side to attain symmetry. In contrast, such interventions are less frequently performed in flap reconstruction. (47)

Because IBR, in its various styles, sometimes has unique complications, it is imperative to be conducted by highly skilled healthcare professionals in specialized hospitals. This has been demonstrated to significantly enhance surgical success rates and reduce postoperative complications, consequently reducing wound or flap complications and ultimately leading to improved overall patient results. (48)

5 Conclusion.

In conclusion, immediate implant-based reconstruction has gained significant acceptance due to its advantages, including a single surgical procedure, shorter recovery time, and reduced psychological burden. However, its suitability should be assessed based on individual patient factors.

Immediate autologous reconstruction offers advantages such as improved aesthetic outcomes and long-term durability.

Implant-based reconstruction requires frequent office visits for tissue expansion and may involve periodic implant removal or replacement. In contrast, AR allows for natural breast changes and can provide additional benefits like a flatter abdomen.

The expertise of specialized surgeons is crucial in minimizing complications and optimizing patient outcomes in both IBR and AR. Careful consideration of patient preferences, resource accessibility, and surgical suitability is necessary for selecting the appropriate approach. Specialized surgeons and healthcare centers play a vital role in ensuring successful outcomes.

6 Summary

In summary, IBR offers unique advantages, and its various techniques should be considered in suitable cases. Patient factors, surgical expertise, and resource availability should guide the decision-making process for optimal immediate breast reconstruction outcomes.

Keywords: Autologous reconstruction, Breast reconstruction, Flap reconstruction, Immediate breast reconstruction, Implant-based reconstruction, Mastectomy, Tissue expander.

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8 Curriculum Vitae

Michael Martin is a German citizen born in Munich on May 16, 1998. He completed his Abitur at the Gymnasium der Benediktiner Kloster Schaeftlarn in Munich in 2016. In 2017, he enrolled in the Medical University of Rijeka to study medicine, where he is pursuing his degree. In addition to his studies, Michael has gained practical experience in various medical fields through several internships, gaining valuable insights and skills. These experiences have given him a unique perspective and a deep understanding of the complexities of the medical field. Michael enjoys playing golf, tennis, and chess outside of medicine. He is fluent in German and English, with a proficiency level of B1 in Croatian. Additionally, he has achieved the Latinum and Graecum, demonstrating his proficiency in Latin and Ancient Greek.