CASE REPORT
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Breast reconstruction through autologous flaps following mastectomy in breast cancer patients: a case series

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ABSTRACT

Introduction: Breast reconstruction for breast cancer has evolved to be associated with a health function through autologous flaps and an aesthetic benefit of applying breast implants. However, health function is preferred in developing countries, including Indonesia. Consequently, the breast reconstruction selection focuses on the autologous flap, where the transplant flaps are taken from the patient body.

Objective: This study reports four types of autologous flaps often performed in the Oncology Department of Hasanuddin University Academic Hospital, Makassar, Indonesia. The four flaps are *Transverse Rectus Abdominal Myocutaneus* (TRAM); *Lattisimus Dorsi* (LD); *Horseshoe*; and *Thoracoabdominal* (TA). We report those cases related to each flap surgical technique and the advantages and disadvantages.

Methodology: This study is a case series of four autologous flap procedures on breast reconstruction of breast cancer patients: *TRAM, LD, Horseshoe,* and *TA* flaps. The case series is supported by a literature review regarding the related flap reconstruction studies published within the last 5 years (2018-2023).

Results: Four female patients with locally advanced breast cancer underwent breast reconstruction through four different types of flaps: *TRAM*, *LD, Horseshoe*, and *TA*. Pathological diagnosis revealed *invasive mammary carcinoma* in 3 patients and *invasive ductal mammary carcinoma* in 1 patient. The procedures were pedicle regional flaps without vascular anastomosis immediately after mastectomy. The four flaps did not provide any significant complications. A year post-surgery, patients are able to do activities. The post-reconstructive wounds have adequate vascularity and create a flat, good aesthetic shape, yet they are not symmetrical with the contralateral breast.

Conclusion: Each procedure has a different feasibility level, advantages, and disadvantages. These four flaps are an excellent and reliable choice for breast reconstruction in advanced breast cancer patients.

Keywords: autologous flaps, breast reconstruction, breast cancer, TRAM flap, LD flap, Horseshoe Flap, TA Flap.
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INTRODUCTION

Breast cancer is the most common type of cancer in the world.[1] Global Cancer (GLOBOCAN)(2020) stated that the number of deaths due to breast cancer was 684,996 patients (6.9%),[1] where Asia had the highest mortality rate and a 5-year survival rate of breast cancer among other continents (50.5% and 41.3%, respectively).[1] The Surveillance, Epidemiology, and End Result (SEER), National Cancer Institute (NCI) of the United States (March 2023) reported the mortality rate of breast cancer in the United States was 7.1%, with a 5-year survival rate of 90.6% (2012-2018)(SEER-NIH, 2023).[2] Breast cancer was the most common cancer (16.6%) in the Indonesian population, with a 5-year survival rate of 201,143 patients (148.11 patients per 100,000 population), which was the highest number of cancer survivors among all other cancer types (GLOBOCAN-2020).[3] In contrast, the mortality rate of breast cancer in Indonesia ranked at the second position (9.6%) after lung cancer (GLOBOCAN-2020).[3] These data show that breast cancer treatment in Indonesia has a high level of efficacy (GLOBOCAN-2020).[3]

Techniques of breast cancer surgery and breast reconstruction, especially in women, are quite increasing today.[4] Women have several options for reconstruction procedures that provide aesthetic improvements and benefits for psychology patients.[4] The breast reconstruction was performed by using implants or with autologous tissue, such as muscle or skin flaps.[4] Most patients with breast cancer prefer autologous tissue over breast implants.[4] Autologue tissue in the breast reconstruction does not involve distant flaps.[4] This technique reduces an immune reaction between the transplanted (donor) and recipient tissues because the transplanted tissues are taken from the patient body.[4]

Autologous flap is the only type of breast reconstruction that we performed at the Oncology Department of Hasanuddin University Academic Hospital, Makassar, Indonesia. This musculocutaneous flap transfers a substantial amount of skin, fat tissue, and muscle from the back, thorax, and abdomen to the breast

reconstruction area.[4] Although it does not restore the original shape of the breast, the flap procedure is still an excellent option due to the needs of our patients, who prioritize health over aesthetics.[4] There are four breast reconstruction flaps that we reported: *transverse rectus abdominal myocutaneus* (TRAM) flap; lattisimus dorsi (LD) flap; *Horseshoe* flap; and thoracoabdominal (TA) flap. The four procedures were performed using pedicle regional flaps, which did not require vascular anastomosis during intraoperative reconstruction.[4] The type of reconstruction technique was selected based on the clinical condition, the patient choice, and the expertise of our surgeons.[4] This paper reported surgical techniques, feasibility, and complications of each flap. We also supported this report with a literature review regarding the advantages and disadvantages of each flap procedure.

METHODS

This paper is a case series reporting four types of breast reconstruction flap procedures in four different breast cancer patients. The procedures are most commonly performed in the Academic Hospital of Hasanuddin University, Makassar, Indonesia. The four procedures are (1) tranverse rectus abdominal (TRAM) flap; (2) lattisimus dorsi (LD) flap; (3) Horseshoe flap; and (4) thoracoabdominal (TA) flap. These procedures were performed within 2 years of the time (2021-2022).

This paper is also supported by review articles derived from several scientific references about breast reconstruction, breast cancer, and the four flap procedures. References were taken from the world's largest online library (Public Media Library - PUBMED, National Institue of Health-NIH) published in the last 5 years (2018-2023). The online PUBMED search for "full-text free access" showed that the number of references for each flap (on March 2023) was: TRAM 36 articles, LD 45 articles, Horseshoe 1 article, and TA 3 articles. Statistical data was taken from official health institutions. World and continent data were taken from the World Health Organization (WHO) and Globocan (2020).[1] United States data were taken from annual SEER and NCI (2023).[2] Indonesian data were taken from WHO and Globocan (2020).[3]

This paper obtained perioperative and intraoperative data from January 2021 to December 2022, written using *Microsoft Office Word 2020*, managed by *Mendeley References Manager 2021*.

RESULTS

Breast cancer treatment procedures in Indonesia are effective, based on the highest number of breast cancer survivors in the population.[3] The procedures include chemotherapy, surgery, radiotherapy, and rehabilitation.[3,4] In this paper, we report 4 types of breast reconstruction procedures after radical mastectomy surgery and neoadjuvant chemotherapy. The breast reconstruction performed in our hospital was an autologous flap, where the flap donor was obtained from the patient body, in consideration of immune reaction, and easy fast accessibility to harvest the flap before the reconstruction.[4] The four flap procedures are (1) *Transverse Rectus Abdominal* (TRAM) flap; (2) *Lattisimus Dorsi* (LD) flap; (3) *Horseshoe flap*; and (4) *Thoracoabdominal* (TA) flap.

CASE 1: TRANSVERSE RECTUS ABDOMINAL MYOCUTANEUS (TRAM) FLAP

A woman, 51 years old, body mass index (BMI) of 21.4 kg/cm^2, had a right breast lump for 12 months but progressively enlarged in the last 4 months before admission to the hospital. Physical examination showed a 7 cm x 3 cm x 1.5 cm lump, hard solid, not fixed, painful, and not well-demarcated (Figure 1-1). Lymph node enlargement was palpated in the right armpit, which was 1.5 cm in size, hard solid, and well-demarcated. Laboratory findings were normal. The radiologic examination did not show distant metastases (Thoracic X-ray and Whole Abdomen Ultrasound). The patient had undergone an incisional biopsy with a pathological finding of *Invasive Mammary Carcinoma WHO Grade 3*. The patient was diagnosed with a right breast carcinoma, cT4bN2M0, and received 3 cycles of neoadjuvant chemotherapy. The following treatment was modified radical mastectomy (MRM) with a transverse rectus abdominal myocutaneus (TRAM) flap reconstruction.

This patient underwent MRM and TRAM flap reconstruction. The mastectomy incision was made in the lump of the right breast with a 2 cm margin. In contrast, the abdominal flap incision was performed in the hypogastric region covering four *Hartramph* vascularized zones (I-IV)(Figure 1-1). Mastectomy removed radically the breast tumor tissue and fat, measuring 9 cm x 5 cm x 2 cm, leaving the skin envelope (Figure 1-1). Afterward, the abdominal flap was harvested with a horizontal elliptical incision, preserving the superior epigastric artery pedicle (Figure 1-1). Tunneling initiated flap transposition from the xiphoideus processus to the medial mammary fold and closed the mastectomy defect on the right breast (Figure 1-2). The patient was hospitalized until 5 days postoperatively, with a total seroma drainage of 1250 cc in the mammary drain and around 430 cc in the abdominal drain (Table 1). One year postoperative, the post-reconstruction wound showed that sutures on the donor and recipient sites healed optimally without significant complications (Figure 1-2).

CASE 2: FLAP LATTISIMUS DORSI (LD) FLAP

A woman, 54 years old, BMI of 24.9 kg/cm^2, presented with a history of left breast lump since 1 year before admission. The lump was painless. Physical examination revealed a mass measuring 15 cm x 10 cm x 1.5 cm in all quadrants of the left breast (Figure 2-1). The mass was fixed to the breast tissue. There were cicatrix tissues and eschoriation in the skin but no signs of inflammatory cancer. Laboratory investigations were within normal limits. Radiologic examination showed multiple enlarged axillary glands at levels I and II (breast ultrasound), with no signs of distant metastasis (Whole Abdomen Ultrasound and Thoracic X-Ray). The patient had an incisional biopsy with a pathological result of *Invasive Carcinoma Mammae*. The patient was diagnosed with a left breast carcinoma, cT4bN2M0, and had already finished neo-adjuvant chemotherapy for 3 cycles. The patient was planned for modified radical mastectomy (MRM) with a breast defect reconstruction using Lattisimus Dorsi (LD) flap.

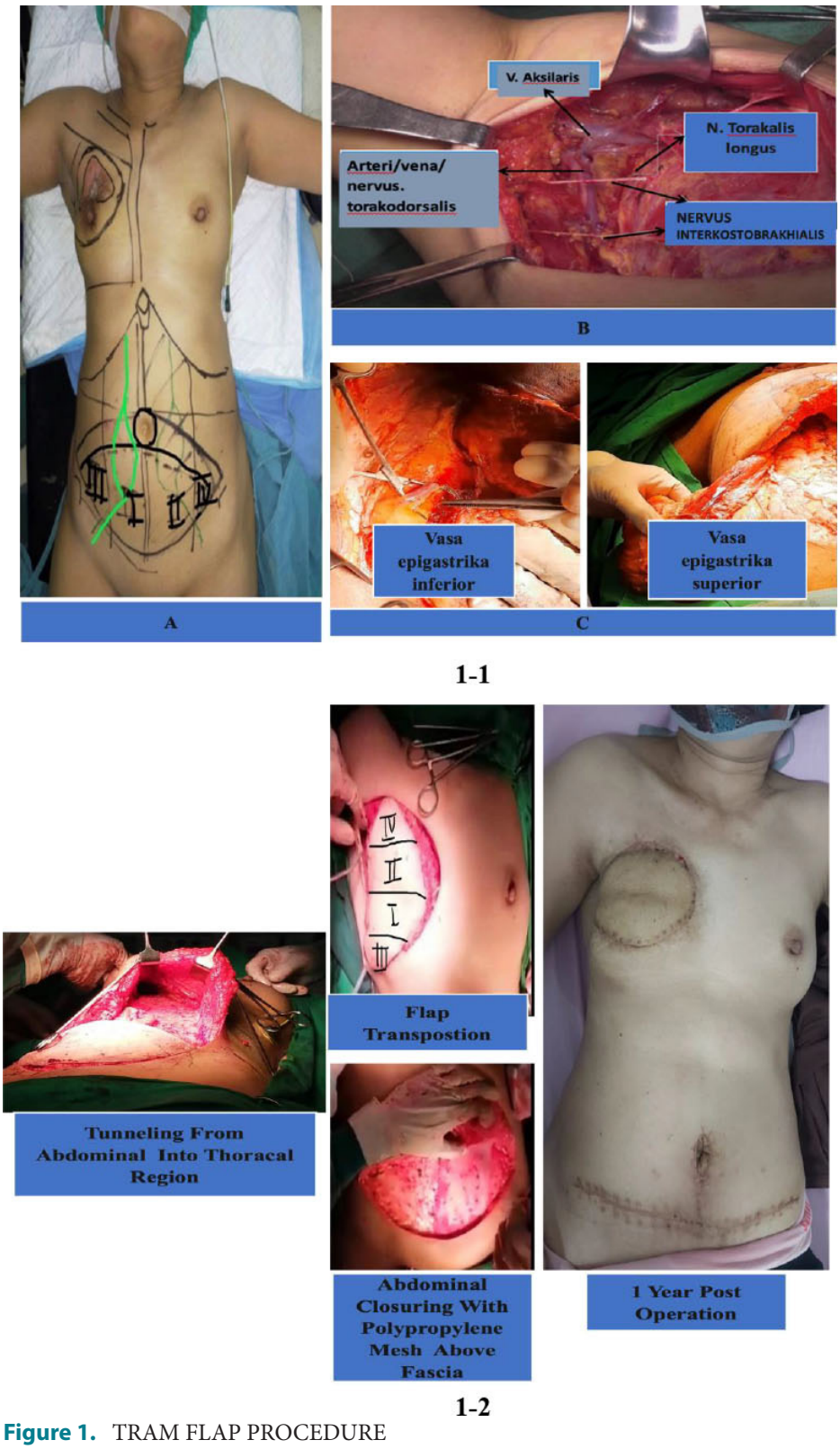


Figure 1. TRAM FLAP PROCEDURE
1-1. Tram FLap Incision; (A) Incision Design, (B) Vascular and Nerve Preservation at Recipient Site, (C) Vascular Preservation at Donor Site
1-2. Tunneling, Closuring, and Post-Operation Result

We designed the MRM incision over the tumor with a 2 cm of margin (Figure 2-1). The flap was designed on the left dorsal back above the elliptical musculus lattisimus dorsi, measuring 25 cm x 10 cm (Figure 2-1). The mastectomy procedure was performed by removing the tumor tissue and skin, along with the areola 17 cm x 12 cm x 2 cm in size (Figure 2-2). On the contrary, a horizontal elliptical flap excision was performed on the left dorsal back (Figure 2-2), followed by harvesting the flap with preservation of the thoracodorsal artery bundle sheath and tunneling the flap through the left axilla to close the mastectomy defect in the left thoracal anterior. The patient was hospitalized until the third day (Figure 2-3), with total seroma drainage of 750 cc in the breast drain and 105 cc in the back.

CASE 3: HORSESHOE FLAP

A 50-year-old woman with a BMI of 22.1 kg/cm^2 presented with a left breast lump that had enlarged in the last 3 months before admission. The lump was located on the left lateral quadrant and was painless. The patient did not experience anorexia or weight loss. Physical examination showed a dry ulcerous mass measuring 2 cm x 2 cm x 1 cm, firm, fixed to the breast tissue and thoracal wall, and well-demarcated (Figure 3-1). Nipple retraction and peau d'orange were found. Laboratory examination was within normal limits. Radiologic examination showed no signs of metastasis (Thoracic X-Ray and Whole Abdomen Ultrasound). The patient underwent incisional biopsy surgery, with a pathological diagnosis of *Invasive Ductal Carcinoma Mammae*. The patient was then diagnosed with left breast carcinoma, cT4bN0M0, and underwent neo-adjuvant chemotherapy 3 times. The patient was planned modified radical mastectomy (MRM) with a 2 cm margin and a reconstruction of breast defect using a Horseshoe Flap.

We designed MRM and flap incisions on the skin on the same side as the tumor (Figure 3-1). After mastectomy, we obtained a tumor and fat mass measuring 6 cm x 7 cm x 1 cm with a circular defect (Figure 3-1). Subsequently, a semicircular harvesting flap was performed to cover the surrounding mastectomy defect on horseshoe-shaped reconstruction (Figure 3-2). The patient was hospitalized for 3 days after surgery, with a drain volume of 200 cc. The patient was discharged without complications or significant abnormalities. The flap after 1 year showed a minimal scar and optimal vascularization (Figure 3-3).

Figure 2. LD FLAP PROCEDURE.
2-1. Incision Design; 2-2. Harvesting Flap; 2-3. Post Operation Result

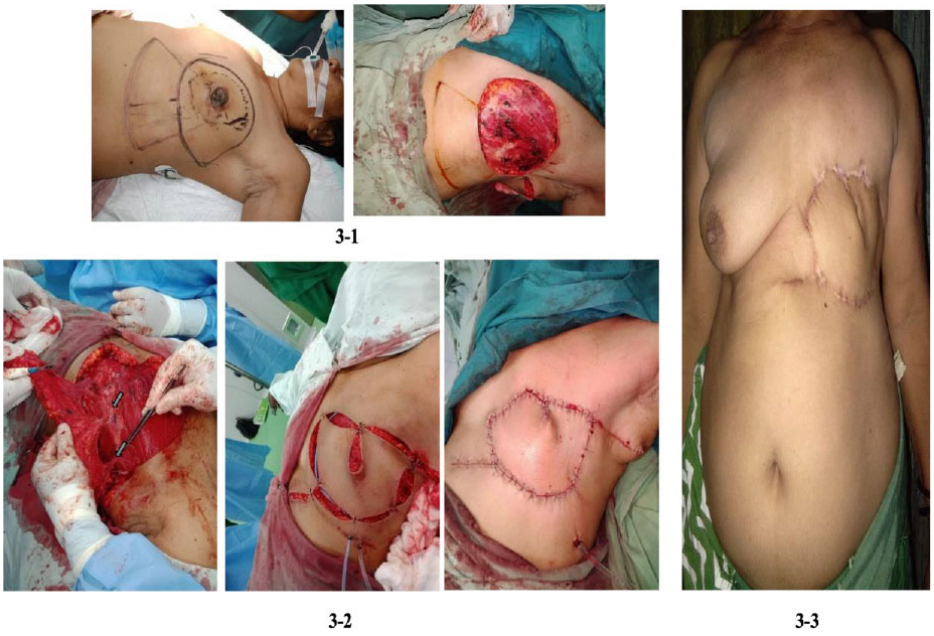
CASE 4: THORACOABDOMINAL (TA) FLAP

A woman, 46 years old, BMI of 22.1 kg/cm^2, presented with a right breast lump that had been increasing in size within the last 2 years before admission. The lump was painless. Physical examination revealed a mass measuring 20 cm x 15 cm x 1 cm, hard solid, and fixed to the breast tissue (Figure 4-1). There was a post-incision cicatrix on the skin, but signs of inflammatory cancer were absent. Laboratory examination was within normal limits. Radiologic examination showed no signs of metastasis (thoracic X-ray and whole abdomen ultrasound). The patient had an incisional biopsy with a pathological result of *Invasive Carcinoma Mammae*. The patient was diagnosed with a right breast carcinoma, cT4bN0M0, and underwent 3 cycles of neoadjuvant chemotherapy. As a follow-up management, modified radical mastectomy (MRM) was performed with defect reconstruction using a Thoracoabdominal (TA) Flap.

We designed an MRM incision over the right breast tumor with a TA flap pattern in the right thoracic and abdominal areas (Figure 4-1). After mastectomy, an oval-shaped MRM defect measuring 20 cm x 15 cm x 2 cm was obtained (Figure 4-2). Flap harvesting was performed with a linear verticle incision on the anterior thorax and abdomen, followed by closing the mastectomy defect (Figure 4-3). The patient was hospitalized for 3 days, with seroma drainage production of 210 cc. The patient was discharged without complications or significant abnormalities.

DISCUSSION

An autologous tissue flap is the only procedure of breast reconstruction for breast cancer performed in the Oncology Surgery Department Hasanuddin University, Indonesia. This paper reported four female locally advanced breast cancer patients who underwent breast reconstruction with four different flap types. The flaps are TRAM, LD, Horseshoe, and TA. The pathological diagnoses consisted of *Invasive Mammary Carcinoma* in 3 patients and *Invasive Ductal Mammary Carcinoma* in 1 patient (Table 1). Our flap procedures were a regional pedicle flap without vascular anastomosis immediately after mastectomy. Before the procedure, all four patients had undergone neoadjuvant chemotherapy for 3 cycles. The patients had the following characteristics: mean age of 50.5 years, mean BMI of 23.33 kg/cm^2 (normal range), where BMI is directly proportional to tumor volume; the largest tumor volume was measured on TA flap (600 cm^3), and the skinniest was on the Horshoe flap (42 cm^3). The



3-1 3-2 3-3

Figure 3. HORSESHOE FLAP PROCEDURE.
3-1. Incision Design; 3-2. Harvesting Flap and Closuring MRM Defect;
3-3. One Year Post Operation

4-1 4-2 4-3

Figure 4. TA FLAP PROCEDURE
4-1. Incision Design; 4-2. MRM Procedure and Harvesting Flap;
4-3. Closuring MRM Defect

longest operation time was found on the TRAM flap, and the fastest time was on the Horseshoe flap; the highest drain volume was the TRAM flap (900cc), and the lowest volume was the Horseshoe flap (200cc); the longest postoperative care was on the TRAM flap (5 days), and the lowest one was found on the three other flaps (3 days). The positive lymph node enlargement was identified on TRAM and LD flaps (Table 1). All four flap procedures had no significant complications. One year post-operation, all four patients could perform their usual activities. The post-reconstruction wound showed adequate vascularizations and a flat, good aesthetic shape, yet not symmetrical with the contralateral breast.

TRAM flap is the most frequent flap in breast reconstruction.[5–8] This flap is viable, with survival rates of 100% (Table 2).[5] We performed a musculus-sparing TRAM (MS-TRAM) pedicle flap.[5–8] In this procedure, we harvested the MS-TRAM flap, containing rectus abdominis muscle, fat, subcutaneous tissue, and epithelium.[5–8] The adjusted epithelium of *Hartrampf zone* II *and* III are exfoliated due to their location in the lateral flap before being transplanted in the mastectomy defect by using a skin graft mesher (Figure 1-2).[5–9] *Hartrampf Zona* I was de-epitheled in the center flap, which was anastomosed with the enveloped skin at the mastectomy defect (Figure 1-2).[9] This flap contains the pedicle sheath from the superior epigastric veins and arteries (Figure 1-1C), that perfuse the peripheral vasculature of the *Hartrampf zone I-III. T*hus, we removed zone IV (Figure 5).[9,10] Postoperatively, the entire wound of the recipient breast healed optimally without significant complications.[11] This indicates that the flap and the underlying tissue received optimal vascular perfusion.[5–9] On the other handthe polyproline mesh was placed on the donor site immediately after flap transposition to prevent intestinal hernia.[12] One year postoperatively, the surgical wound healed optimally and showed no other complications, such as regional recurrence[11], distant metastasis[11], abdominal hernia[12], or shoulder deformity[13] (Figure 1-3).

Tissue perfusion and tissue transplant volume are primary determinants of MS-TRAM flap.[5,9] Tissue perfusion supports adequate blood supply to avoid necrosis and flap loss.[9,10] Necrosis and flap loss occur due to arterial thrombosis or venous congestion, mainly in obese patients.[10,14–16] The conventional pedicle MS-TRAM flap was vascularized by a branch of the superior epigastric artery, where green fluorescence showed that zone IV was not adequately perfused (Figure 5). [9] *Chirapappa et al. (2020)* identified perfusion patterns in MS-TRAM flaps pedicle, consisting of sequential, simultaneous, low medial scar, and delayed; which only vascularized zones *I-III of Hartrampf*.[9] Therefore, *Hartrampf zone IV* is always removed in this procedure.[9]

Free-flap TRAM performs vascular anastomosis intraoperatively.[5,17] The number and diameter of perforators/ pedicles (including veins) determine tissue perfusion.[5,18] Flaps with 2 or more pedicles provide adequate blood flow for large soft tissue volumes.[5,18] Pedicle recipient flaps for anastomosis can be performed on thoracodorsal vessels and internal mammary vessels.[5,17] Both recipients are safe and efficient in breast reconstruction, concerning complication and aesthetic results.[5,18] *Geierlehner et al. (2022)* reported TRAM-free pedicles derived from inferior epigastric vessels, which were anastomosed with the

Table 1. Patient Characteristics

CRITERIA	TRAM	LD	HORSESHOE	TA	MEAN
Age (Year)	52 years	54 years	50 years	46 years	50.5 years
Body Weight (kg)	55 kg	60 kg	53 kg	56 kg	56 kg
Height (cm)	168 cm	165 cm	155 cm	150 cm	159.5 cm
IMT (kg/cm^2)	19.5	24.9	22.1	24.9	23.33
Pathological Result	*Ca. Mammae Invasive*	*Ca. Mammae Invasive*	*Ca. Mammae Ductal Invasive*	*Ca. Mammae Invasive*	-
Tumor Volume (cm^3)	9 x 5 x 2 90 cm^3	17 x 12 x 2 168 cm^3	6 x 7 x 1 42 cm^3	20 x 15 x 2 600 cm^3	-
Operation Duration	6 hours 30 minutes	5 hours 30 minutes	3 hours	3 hours 30 minutes	4 hours 37 minutes
Drain Volume In 3 days (cc)	900 cc	750 cc	200 cc	210 cc	515 cc
Length Hospital Stay (Day)	5 days	3 days	3 days	3 days	3.5 days
Node Metastase	+	+	-	-	-

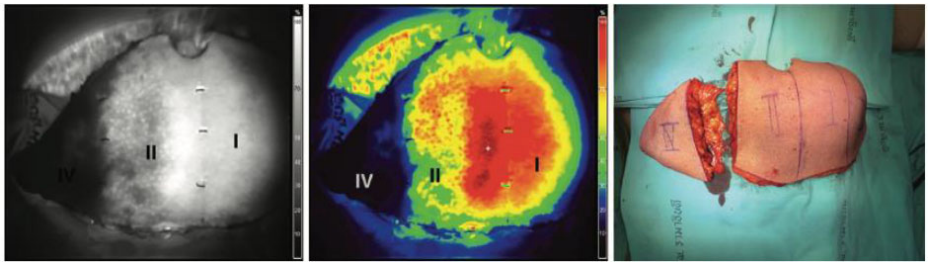


Figure 5. Perfusion Of MS-TRAM Flap (*Permission of Chirappapha et. al. 2020*)[9]

Table 2. Advantages and Disadvantages of Rectus Abdominis Myocutaneus Transfer Flap

TRANSVERSE RECTUS ABDOMINIS MYOCUTANEUS (TRAM) FLAP	
ADVANTAGES	**DISADVANTAGES**
1. Viable flap with a high survival rate (100%).[5,6,9]	1. Long duration of operation.
2. Provides an aesthetic effect, especially for patients with large breasts and significant ptosis.[5,20]	2. Envelope necrosis or flap loss, especially in obese.[10,14–16]
3. Supports nipple-sparing mastectomy (NSM) with a good aesthetic outcome.[6,21]	3. Prolonged impact of distant metastases and regional recurrence.[11]
4. Preserves shoulder function after mastectomy.[13]	4. Abdominal wall hernia.[12]
5. Less seroma formation at the donor site with a faster healing time.[19]	5. Infection.[22]

Table 3. Advantages and Disadvantages of Lattisimus Dorsi Flap

LATTISIMUS DORSI (LD) FLAP	
ADVANTAGES	**DISADVANTAGES**
1. An excellent option if an abdominal flap cannot be performed.[23–25]	1. Decreases shoulder endurance or causes functional arm impairment.[23,31,32,35,39]
2. A flap rescue option to save a failed flap, with superior aesthetics.[25,32–34]	2. Flap necrosis due to venous and/or arterial congestion/thrombosis.[30,33]
3. Safe procedure and does not affect basic activities.[13,35–37]	3. Infection at the donor site and graft site.[32,33]
4. Can be performed in obese patients,[27,29,38] and in advanced cancer patients[23]	4. Wound dehiscence.[32,33]
5. Axillary lymphonodus dissection is possible.[26]	5. Seroma[32,33,39,40]
	6. May form an elongated solified hematoma that cannot be treated by aspiration.[41]
	7. Minor twitching and pain.[23]

recipient's internal mammary vessels.[5] The study showed mean arterial blood flow of the flap did not significantly increase after anastomosis, and this flap had lower vascular resistance, resulting in smaller ischemia transit time.[5] The study showed a 100% flap survival rate.[5]

In addition, the volume of seroma production is significant in TRAM flaps related to healing time.[19] In our report, seroma production on the recipient site has the highest volume among all flaps (900 cc/3 days)(Table 1), causing the longest hospital stay (5 days)(Table 1). In contrast, seroma production on the donor site was only about 5 cc on the fifth day, which led to the patient being discharged without an abdominal drain. Additionally, a study mentioned that suture technique during abdominoplasty on both free- and pedicle-TRAM flaps is important.[19] Abdominoplasty with progressive tension suture (PTS) or conventional suture results in a low drain volume, no seroma formation, and less wound dehiscence in the donor area.[19] Patients have shorter healing times and hospital stays.[19] A review of the advantages and disadvantages of TRAM flaps is listed in Table 2.

The lattisimus dorsi (LD) flap is an excellent choice for breast reconstruction if an abdominal flap cannot be performed (Table 3).[23–25] This flap allows ipsilateral axillary lymph node dissection, making it an appropriate choice for cases with lymph node metastases.[26] In the LD procedure, we used pedices from the thoracodorsal arteries.[27–29] After harvesting the flap and preserving the bundle sheath of the thoracodorsal vessels, tunneling

Table 4. Advantages and Disadvantages of Horseshoe Flap[42]

HORSESHOE FLAP	
ADVANTAGES	**DISADVANTAGES**
1. Shorter operation time and easier technique. 2. Simple postoperative care and good aesthetic results. 3. Perfect perforator supply, which results in minimal damage. 4. Applicable for various sizes of mastectomy defects (diameter: 4-26 cm)	1. Partial Necrotic

Table 5. Advantages and Disadvantages of Thoracoabdominal (TA) Flap

THORACOABDOMINAL (TA) FLAP	
ADVANTAGES	**DISADVANTAGES**
1. A simple design that minimizes complications to the donor site.[43–45] 2. Easy to perform and cost-effective.[43] 3. Fast wound recovery[45]	1. Superficial necrosis[43–45] 2. Major flap loss[44,45] 3. Locoregional recurrence[44]

is made in the subcutaneous tissue under the armpit (Figure 2-2).[26] This was followed by transferring the flap and pedicle to the breast pocket via the tunnel, with the anterior movement of the rotational flap, and finally closing the mastectomy defect (Figure 2-2).[27–29] Intraoperatively, we performed level I and II axillary lymphonodus dissections, which did not infiltrate the axillary nerve.[26] Postoperative care showed no infection, wound dehiscence, seroma, necrosis, or hematoma (Figure 2-3).[27–29] The 1-year postoperative follow-up showed a flat flap with excellent healing, and the patient did not experience shoulder deformities and a decreased quality of life (Figure 2-3).

LD pedicle flaps are relatively easy to harvest.[30] However, complications and deformities are still frequently reported.[30] The LD flap haseveral long pedicles (mean 8.5 cm), large in diameter (mean 3 mm), and easily distinguishable from other structures on the flap.[30] The main pedicle of this flap is the thoracodorsal arteries.[27–29] Pedicle disruption may occur due to pedicle rotation error when placing the flap in the breast pocket, postoperative torsion, or compression.[30] Pedicle disruption leads to pedicle kinking, vascular thrombosis, necrosis, and flap loss.[30] *Maitani et al. (2020)* reported a case of necrosis due to pedicle kinking and successfully salvaged the flap with emergency pedicle repair surgery and thrombolytic therapy through the serratus anterior artery (thoracodorsal branch artery).[30]

The LD flap also involves large LD muscles attached to several important functional muscles.[31] There are three danger zones during LD flap harvesting: 1) zone 1 involves the LD and thoracolumbar fascia.[31] The thoracolumbar fascia is the myofascial belt of the lower body, which, if damaged, will cause paraspinal muscle hernias, chronic back pain, and scoliosis.[31] 2) zone 2, the attachment between LD, *Musculus oblique external* (MOE), and *Musculus Serratus Anterior* (MSA).[31] The MSA and *Trapezius Muscles* are responsible for scapular stability and shoulder movement, which limit arm movement (abduction and flexion) and cause chronic pain.[31] 3) Zone 3, where the LD attaches to the *Musculus Serratus Posterior Inferior* (SPI) and MOE.[31] The MOE and *Musculus Internal Oblique* are responsible for supporting the torso, rotational movement, and compression of the abdominal cavity, which affect postural stability and ambulatory movement (when walking or running).[31] A study confirmed that the LD flalimits shoulder movement, mainly flexion, extension, and internal rotation.[13] However, statistical calculations showed the complication in the shoulder movement was not significant, and most patients experienced improvement in shoulder movement within 8 weeks postoperatively.[13] Therefore, it was concluded that the LD flap did not decrease patient life quality.[13] Table 3 reviews the advantages and disadvantages of LD flaps in breast reconstruction.

Horseshoe flap is rarely reported due to its small application in breast reconstruction.[42] It is a local flap using tissue surrounding the mastectomy defect (chest wall).[42] It has the shortest duration of surgery (3 hours)(Table 1). Our horseshoe flap forms a circular defect (Figure 3-1) based on the principle that safe and adequate tumor margins are obtained with a circular incision (Figure 6).[42] This method perfectly provides minimum wound tension, ensuring adequate dermal perfusion.[42] The donor flap is taken from the outermost circular area with the widest arc, including the epithelium, subcutaneous, and fat layers.[42] The flap harvesting technique uses an angle of 120 degrees, causing the flap to close the mastectomy defect 100%.[42] Postoperative wound healing is easier.[42] This flap produces the least seroma (200 cc)(Table 1). After 1 year postoperative, the aesthetics wound was good, with minimal cicatrix tissues and a flat wound shape (Figure 3-3).

The horseshoe flap has an excellent perforator supply, produces minimal damage, and is easy to perform.[42]The source of the flap comes from the surrounding tissue of the mastectomy defect.[42] This flap has multiple perforators that ensure better flap viability.[42] *Suryawisesa et al. (2022)* reported that this flap has a variety of mastectomy defect sizes, ranging from the narrowest diameter (4 cm) to the widest diameter (26 cm).[42] The study concluded a 120-degree angle flap optimally covered the entire mastectomy defect.[42] However, partial necrotic lesions may occur at the broadest defect (26 cm).[42] The necrotics are managed by removing necrotic tissues and re-sealing the defect by performing primary sutures.[42] In 30 days post necrotomy, the flap is viable and healing completely.[42] The advantages and disadvantages of the Horseshoe flap are listed in Table 4.

A thoracodorsal (TA) flap is a localized flap that uses tissue around the mastectomy defect.[43–45] We performed the TA flap immediately after mastectomy. The flap harvesting began with a vertical linear incision in the ipsilateral linea mid-sternalis, with the upper margin of the medial edge of the mastectomy defect (Figure 4-2).[44] Then, we sharpened the incision to the epithelium's lower layer, reaching the subcutaneous layer and fascia (Figure 4-2).[43–45] The harvesting was continued to the lateral margin at the anterior axillary line and the lower margin at the level of the umbilicus (Figure 4-3).[44] During harvesting, we performed a lateral

perforator set dissection. The principle of the TA flap is maintaining dissection above the fascia layer.[44] After harvesting, the flap is rotated to cover the mastectomy defect (Figure 4-3).[43,44] followed by anastomosis of the flap's lateral side with the chest-abdominal wall's medial side (Figure 4-3).[43,44] The patient was hospitalized for 3 days without significant complications (Table 1).

TA flap is a fasciocutaneous flap with a C-type rotational movement that repositions the skin, subcutaneous tissue, and fascia to a mastectomy defect (Figure 4).[44,45] This flap is easy to perform without identifying the perforator or pedicle.[43] However, the source of the perforator/pedicle is important.[44] Lateral perforators originate from the subcostal and intercostal arteries, while medial-lateral perforators originate from the bifurcation of the deep epigastric arteries and musculus rectus abdominis lateral arteries.[44] This is related to the choice of the incision, medial incision, or lateral incision, particularly for patients with extensive mastectomy and obesity.[44,45] Line dissections of this flap are the midline sternal on the medial side, the anterior axillary line on the lateral side, and the *superior anterior spinal tuberculum* (SIAS) on the inferior side.[44] A review of the advantages and disadvantages of Thoracoabdominal flaps is listed in Table 5.

CONCLUSION

Breast cancer patients in Indonesia prefer breast reconstruction with autologous flaps rather than implants. The autologous reconstruction uses tissue flaps from the patient body, prioritizing health functions over aesthetic benefits. We report The four flap procedures: *Musculus Sparing (MS)-TRAM* Flap, *LD* Flap, *Horseshoe* Flap, and *TA* Flap. Each flap procedure has a different feasibility level, advantages, and disadvantages. These four flaps are an excellent and reliable option for breast reconstruction in advanced breast cancer patients.

The preference for a reconstruction flap depends on clinical circumstances, patient choice, and, most importantly, the surgeon's ability. Surgeons are emphasized to minimize complications of breast reconstruction by determining the right flap procedure for each patient. Large-scale follow-up studies of each flap would be beneficial.

DISCLOSURES

The authors confess that this article is an original work. The patients and data were real objects obtained from preoperative examinations, intraoperative findings, and postoperative care. The authors followed the patient until one-year post-surgery.

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CONFLICT OF INTEREST

All authors have no conflict of interest to declare

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