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MICROSURGERY IN A TERTIARY HOSPITAL IN EAST KALIMANTAN: A FIVE-YEAR RETROSPECTIVE STUDY FROM PLASTIC SURGERY DIVISION

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ABSTRACT

Introduction: Microsurgery is a critical pillar of modern reconstructive surgery, enabling restoration of complex tissue defects. Data on its demography and outcome in East Kalimantan remains unavailable, limiting strategic service planning. This study aimed to describe the perioperative variables and outcome of microsurgical cases at a provincial referral hospital.
Methods: A retrospective study was conducted at the Plastic, Reconstructive, and Aesthetic Surgery Division of Abdoel Wahab Sjahranie Hospital. All patients who underwent microsurgery between January 2020 and December 2024 were included via total sampling. Medical records were reviewed to extract demographic characteristics, referral sources, primary diagnoses, surgical procedures, and free flap outcomes.
Results: A total of 31 surgery in 28 patients, with fluctuating annual distribution (highest in 2020, lowest in 2022). Most patients were male (64.5%) and adults aged 18–60 years (80.7%), predominantly referred from type B hospitals (61.3%). The most frequent diagnosis was complex soft-tissue defects (93.5%), with malignancy, post-burn contracture, chronic wounds, and electrical trauma as leading etiologies. All reconstructions employed free flap transfer with overall success rate was 77.5%, predominance of anterolateral thigh flap (58.1%).
Conclusion: Microsurgical cases at Abdoel Wahab Sjahranie Hospital primarily involved young-to-middle-aged males with complex soft-tissue defects, managed with free flap reconstruction. These findings affirm the hospital's role as a regional microsurgical referral center and highlight the need for strengthened perioperative monitoring and service expansion beyond trauma-related reconstruction.

Highlights:

1. This is the first comprehensive epidemiological analysis of microsurgical cases in East Kalimantan, filling a critical data gap outside Java.
2. Complex soft-tissue defects accounted for 93.5% of cases, all managed with free flap transfer, predominantly anterolateral thigh and radial forearm flaps.
3. The observed free flap success rate of 77.5% demonstrates functional microsurgical capacity at a provincial hospital and highlights targets for improving perioperative monitoring and outcomes.

INTRODUCTION

Microsurgery has transformed modern reconstructive surgery, enabling precise transfer of autologous tissue with reliable vascularity for complex defects. Since its introduction in the 1970s, free flap transfer has become the gold standard for major trauma, post-oncologic, and congenital reconstructions.[1,2] Globally, tertiary referral centers report success rates exceeding 90%, with expanding applications in limb salvage, breast reconstruction, and head and neck surgery.[3-5]

In Indonesia, published microsurgery data predominantly originate from large metropolitan centers on Java Island, including RSUPN Dr. Cipto Mangunkusumo and RSUD Dr. Soetomo, which have documented high-volume free flap experience.[6-8] However, these data cannot be generalized to provinces with different demographic, geographic, and health system profiles. East Kalimantan, characterized by industrial trauma risk and wide geographic distribution, relies on RSUD Abdoel Wahab Sjahranie (AWS) as its top-tier referral hospital. No published data currently describe the epidemiology of microsurgical cases in this region.

Without robust local data, strategic planning for surgical capacity, human resource allocation, and equipment procurement remains reactive and potentially misaligned with the region's true burden of disease. To describe the epidemiological characteristics of microsurgical cases at RSUD AWS, focusing on patient demographics, referral patterns, diagnoses, and surgical procedures.

This research addresses a critical data void in East Kalimantan, offering the first comprehensive, systematically analyzed dataset on microsurgical practice outside Java. It defines local patterns, highlights system needs, and serves as a baseline for future analytic and interventional studies.

METHODS

We retrospectively reviewed the inpatient medical records from the reporting section of Abdoel Wahab Sjahranie General Hospital to identify patients who underwent microsurgery procedures performed by the Plastic, Reconstructive, and Aesthetic Surgery Division between January 2020 and December 2024. Data was cross-referenced with records from the Central Operating Theatre and manual logs maintained by the Plastic Surgery Division. From this collated dataset, a total sampling technique was employed.

The sample consist of medical records that met the inclusion criteria: patients who underwent microsurgery procedure by plastic surgeon within specified period and had complete and clear medical records. Exclusion criteria were incomplete medical records.

We obtained the demographic characteristics of the study population, including age, sex, anatomical region, referrals, diagnosis, etiology, type of microsurgery procedure, success rate, and mortality.

Data were presented descriptively using tables and charts using Microsoft Excel.

This study received an exemption letter from the Health Research Ethics Committee (Ref. No.: 54/KEPK-AWS/VII/2025), dated July 7, 2025.

RESULTS

Procedure Distribution

The annual distribution showed notable fluctuations. The highest incidence was recorded in 2020, with 10 cases. A sharp decline followed in 2021, with only 5 cases, and further decreased to 4 cases in 2022, the lowest figure during the study period. Case numbers subsequently rose to 5 in 2023 and continued to increase to 7 in 2024 (Figure 1).

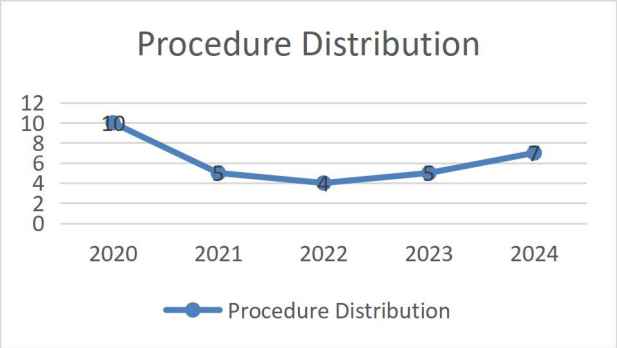

Figure 1. Microsurgery Procedure Distribution in 2020 - 2024

Age, Sex, Referrals and Anatomical Region

This study demonstrated that most subject were male, comprising 20 individuals (64.5%), while females accounted for 11 individuals (35.5%). By age group, the majority were adults aged 18–60 years (n = 25, 80.7%). Children (2–12 years) represented 3 patients (9.7%), adolescents (13–17 years) 2 patients (6.4%), and older adults (>60 years) only 1 patient (3.2%). No cases were recorded in infants (0–1 year) (Table 1).

Table 1. Distribution of Patient Characteristics Undergoing Microsurgery

Characteristics	Frequency (n)	Percentage (%)
Sex		
Men	20	64.5
Women	11	35.5
Age Group (years)		
Infants (0-1)	0	0
Children (2-12)	3	9.7
Adolescent (13-17)	2	6.4
Adult (18-60)	25	80.7
Elderly (>60)	1	3.2
Referrals		
Primary Health Center	7	22.6
Type C Hospital	3	9.7
Type B Hospital	19	61.3
Self-referred / Emergency Unit	2	6.4

Regarding referral sources, most patients were referred from type B hospitals (n = 19, 61.3%). Additional referrals originated from primary health centers (n = 7, 22.6%) and type C hospitals (n = 3, 9.7%), while 2 patients (6.4%) presented directly, and 1 patient (3.2%) came from other sources.

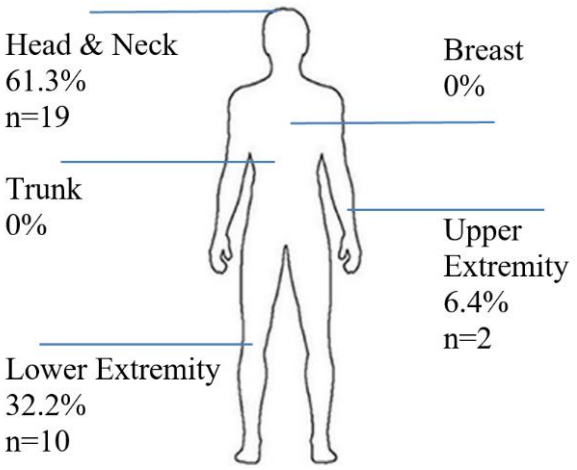

Figure 2. Anatomical Region of Microsurgery Procedure

The illustration (Figure 2) depicts the distribution of microsurgical procedures according to anatomical region. The majority of procedures were performed in the head and neck region (61.3%), followed by the lower extremities (32.2%). A smaller proportion involved the upper extremities (6.4%), while no procedures were recorded in the breast or trunk regions (0% each).

Diagnosis and Etiology

The most frequent diagnosis was complex soft-tissue defect, accounting for 29 cases (93.5%). Two cases (6.4%) were categorized Lymphedema. No cases of bone defect requiring microvascular reconstruction, peripheral nerve injury, traumatic amputation, or post-mastectomy breast defects were identified (Table 2).

From an etiologic perspective, malignancy represented the leading cause (25.8%), followed by post-burn contracture (19.4%), chronic wounds (19.4%), and electrical trauma (16.2%). Less frequent etiologies included flap failure (6.4%), congenital anomalies (6.4%), infection (3.2%), and post-burn keloids (3.2%).

Table 2. Distribution by Diagnosis and Etiology

Characteristics	Frequency (n)	Percentage (%)
Diagnosis		
Complex soft tissue defect	29	93.5
Peripheral nerve injury	0	0
Lymphedema	2	6.4
Traumatic amputation	0	0
Bone defect requiring microvascular reconstruction	0	0
Breast defect post-mastectomy	0	0
Etiology		
Failed Flap	2	6.4
Infection	1	3.2
Malignancy	8	25.8
Congenital anomaly	2	6.4
Post-burn contracture	6	19.4
Post-burn keloid	1	3.2
Chronic wound	6	19.4
Electric injury	5	16.2

Microsurgery Procedure

Table 3. Type of Microsurgery Procedure and Free Flap Selection

Characteristics	Frequency (n)	Percentage (%)
Microsurgery Procedure		
Replantation	0	0
Free Flap	31	100
LVA	0	0
VLNT	0	0
Micro neurorrhaphy	0	0
Others	0	0
Free Flap Selection		
ALT	18	58.1
Radial Forearm	11	35.5
Latissimus Dorsi	1	3.2
SCIP	1	3.2

*Note:
LVA: Lymphovenous Anastomosis
VLNT: Vascularized Lymph Node Transfer
ALT: Anterolateral Thigh
SCIP: Superficial Circumflex Iliac Perforator

All 28 patients during study period were managed with free flap transfer, the total of 31 cases (100%). No other microsurgical techniques were recorded. Among the 31 free flaps performed, the most frequently utilized was the anterolateral thigh (ALT) free flap (18 cases, 58.1%), followed by the radial forearm free flap (11 cases, 35.5%). The latissimus dorsi (LD) free flap and superficial circumflex iliac perforator (SCIP) free flap was each used in only one case (3.2%) (Table 3).

Success Rate and Mortality

A total of 24 cases (77.5%) were successful, while 7 cases (22.5%) resulted in flap failure. Thus, the overall free flap success rate in this study exceeded three-quarters of all procedures. Notably, no patient deaths were reported (0%). These findings indicate a relatively high success rate for microsurgical flap procedures in this cohort, with flap failure occurring in approximately one-fifth of cases and no associated mortality (Table 4).

Table 4. Outcome of Microsurgery Procedure

Indicator	Frequency (n)	Percentage (%)
Successful flap	24	77.5
Failed flap	7	22.5
Deceased	0	0%

Table 5 details the free flap success rates categorized by patient demographic, anatomical region, etiology, and flap type. Women demonstrated a higher success rate (81%) compared to men (75%). Success rates were highest in the Adolescent (100%) and Elderly (100%) groups. The Adult group (18–60 years), which accounted for the majority of cases (n=32 total), had a success rate of 76%. Reconstruction in the Upper Extremity had a 100% success rate, followed by Head and Neck (78%), and Lower Extremity (70%).

Leading etiologies showed variable outcomes. Chronic wound cases had the lowest success rate (50%), while Electric injury cases had a 60% success rate. Malignancy cases demonstrated a 75% success rate. Complete success (100%) was achieved in procedures for prior Failed Flap, Infection, Congenital anomaly, and Post burn contracture. The most frequently utilized flap, the Anterolateral Thigh (ALT) flap, had an 83% success rate (15 successes, 3 failures). The Radial Forearm flap achieved a 72% success rate (8 successes, 3 failures). The Superficial Circumflex Iliac Artery Perforator (SCIP) flap failed in its only attempt (0% success rate).

Table 5. Details of Flap Success Rate

Characteristics	Success (n)	Failure (n)	Success Rate (%)
Sex			
Men	15	5	75
Women	9	2	81
Age Group (Years)			
Children (2-12)	3	1	66
Adolescent (13-17)	2	0	100
Adult (18-60)	25	6	76
Elderly (>60)	1	0	100
Anatomical Region			
Head and Neck	15	4	78
Lower Extremity	7	3	70
Upper Extremity	2	0	100
Etiology			
Failed Flap	2	0	100
Infection	1	0	100
Malignancy	6	2	75
Congenital anomaly	2	0	100
Post-burn contracture	6	0	100
Post-burn keloid	1	0	100
Chronic wound	3	3	50
Electric injury	3	2	60
Free Flap Selection			
ALT	15	3	83
Radial Forearm	8	3	72
Latissimus Dorsi	1	0	100
SCIP	0	1	0

DISCUSSION

This study provides data from a tertiary healthcare provider in a tiered referral system in Indonesia, our hospital became the final reference center around East Kalimantan.

The fluctuating pattern (Figure 1) reflects the impact of health system dynamics, particularly during the COVID-19 pandemic. The sharp decline in 2021–2022 was likely due to the deferral of elective procedures a widely documented global phenomenon, with some studies reporting a surgical volume reduction of up to 48% initially.[8] While some services rebounded post-lockdown, others, like reconstructive and subspecialty procedures, remained below baseline through 2021[9]. The upward trend at Abdoel Wahab Sjahranie General Hospital (Samarinda) from 2023 onward suggests the adaptation and gradual restoration of operative capacity, consistent with global observations, though full recovery may take longer.

Demographic analysis (Table 1) revealed that microsurgical patients at Abdoel Wahab Sjahranie Hospital were predominantly male (64.5%) and of working age (18–60 years, 80.7%). This finding aligns with demographic data from East Kalimantan, where in 2024 the male population accounted for 51.87% compared to 48.13% female.[10] Samarinda city data for the same year showed a similar trend, with 50.85% males and 49.15% females.[11] The predominance of male patients indicates a higher rate of extremity trauma in men, aligning with reports that working-age men are at greater risk for the occupational and traffic accidents that lead to complex microsurgical needs.[11,12]

The high rate of complex soft-tissue defects (93.5% in Table 2) shows that the primary demand for microsurgery is linked to extensive extremities trauma a finding consistent with other reconstructive centers.[13] However, malignancy (25.8%) was the most common specific etiology,

demonstrating the essential and growing role of microsurgery in post-oncologic reconstruction, driven by earlier detection and a focus on quality of life.[14]

Significant proportions of cases involve post-burn contracture (19.4%) and chronic wounds (19.4%), reflecting the persistent burden of burns and chronic ulcers in Indonesia.[15] Electrical trauma (16.2%) also constitutes a substantial share, likely due to the region's industrial environment.[16] Taken together, the case epidemiology reflects a combined burden of trauma, chronic disease, and cancer, reaffirming the hospital's role as the principal referral center for complex reconstruction in East Kalimantan. The exclusive use of free flap reconstruction the "gold standard" underscores its necessity for closing the diverse, extensive defects seen across these etiologies.[17]

The distribution of flap types (Table 3) showed a clear predominance of the ALT free flap (58.1%), reflecting its status as a "workhorse flap" due to its versatility, long pedicle, and low donor-site morbidity, therefore ALT flaps are favoured for extremity and head-and-neck defects.[18] The radial forearm free flap (35.5%) was the second most frequent, utilized for reconstructions requiring thin, pliable tissue.[19] The infrequent use of the LD and SCIP flaps (one case each) reflects their more selective indications, LD flap for large defect and SCIP flap for small to medium defect with more favourable aesthetic donor-site characteristics.[20-21] Thus, reinforcing the suitability of the ALT flap for the majority of the complex tissue defects encountered.

This procedural distribution indicates that microsurgical services at Abdoel Wahab Sjahranie Hospital are primarily focused on the reconstruction of complex soft-tissue defects using free flaps, particularly ALT and radial forearm flaps. These findings align with the epidemiological profile of trauma, chronic wounds, and malignancy in East Kalimantan, reinforcing the hospital's role as a regional referral center capable of delivering contemporary microsurgical reconstruction.

The observed free flap success rate of 77.5%, with a corresponding failure rate of 22.5%, is lower than rates reported from major international centers, where free flap success is generally cited at above 90% .[3, 22,23] This variability is influenced by multiple factors, including case complexity, patient condition, institutional resources, and the experience of the surgical team.

A study in Switzerland reported a free flap success rate of 97%, identifying advanced age, vascular comorbidities, and trauma as risk factors for failure.[23] Conversely, reports from developing countries have documented lower success rates, typically ranging between 70% and 85%, with primary challenges including limited monitoring equipment, workforce constraints, and a high burden of complex trauma cases.[24] The outcomes observed in this study more closely align with those reported by centers in developing regions, which is consistent with the profile of Abdoel Wahab Sjahranie Hospital as a provincial referral institution serving a predominantly trauma and soft-tissue defect population.

The flap failure rate of 22.5% warrants attention as a quality indicator. Contributing factors may include delayed recognition of vascular compromise, limitations in postoperative monitoring capabilities, and the systemic condition of patients who often present with severe trauma or chronic disease. This is consistent with published literature identifying arterial and venous thrombosis, particularly within the first 72 postoperative hours, as the most frequent causes of flap loss.[25]

The data (Table 5) suggests a possible difference in outcomes based on sex, with women exhibiting a higher success rate (81%) than men (75%). Given the small sample size, this finding may not be statistically significant. Similarly, while success rates were 100% for the Adolescent and Elderly groups, the limited number of

cases in these categories means these results should be interpreted cautiously; the 76% success rate observed in the predominant Adult (18–60 years) working-age population is the most robust finding.

The etiology of the defect appears to be a major differentiator of success. Cases related to Chronic Wound (50% success) and Electric Injury (60% success) showed the lowest rates. These low figures highlight that patients with complex vascular compromise, infection, and tissue damage often associated with chronic wounds and severe electrical trauma present the highest technical challenges and risk for flap viability.[26,27] Conversely, cases of Post burn contracture and Malignancy, where the surgical margins are often cleaner and the recipient vessels healthier yielded higher success rates (100% and 75%, respectively).

Regarding anatomical location, the 70% success rate in the Lower Extremity reflects the widely recognized difficulty in treating defects in this region due to poor local vascularity, higher infection rates, and greater impact from patient mobilization.[28]

The high success rate of the Anterolateral Thigh (ALT) flap (83%) reaffirms its status as a reliable workhorse flap. This superior performance, combined with its high frequency of use, suggests surgeons are selecting it appropriately for a wide range of defects[29]. The 100% success rate of the Latissimus Dorsi (LD) flap, though based on a single case, is in line with its known robustness.[30] The complete failure of the SCIP flap (1 failure, 0 successes) should be noted, as this microsurgical technique is highly demanding (difficult dissection, short pedicle, and small vessel diameter) and may reflect a steep initial learning curve or the selection of the flap for particularly challenging defects with limited alternative options.[31]

These findings collectively emphasize the need for enhanced perioperative vigilance and postoperative monitoring for patients with high-risk etiologies (chronic wounds, electric injury) and complex anatomical locations (lower extremity), which are critical to improving the overall success rate toward international standards.

Although the success rate at Abdoel Wahab Sjahranie Hospital has not yet reached the benchmark of major microsurgical centers, achieving a 77.5% success rate nonetheless demonstrates the hospital's capacity to deliver complex microsurgical reconstruction with acceptable outcomes for a provincial referral center. With improvements in monitoring infrastructure, team skill development, and perioperative optimization, flap success rates are expected to approach international standards in the future.

This study highlights the feasibility of complex microsurgical reconstruction in a provincial referral hospital and identifies several avenues for improvement. First, strengthening perioperative monitoring, including routine flap perfusion assessment and rapid re-exploration protocols, could reduce flap loss. Second, expanding non-trauma reconstructive services particularly for post-oncologic and congenital cases would enhance comprehensive care delivery. Third, establishing a regional referral network and preventive programs based on local epidemiology may optimize resource utilization and reduce preventable trauma-related defects.

Future research should explore the impact of standardized flap monitoring protocols on success rates, evaluate patient-reported functional and aesthetic outcomes, and assess cost-effectiveness to guide policy development. A multicenter collaborative registry across Kalimantan could also provide higher-level evidence to benchmark outcomes and identify system-wide gaps.

The strength of this study lies in its complete inclusion of all microsurgical cases over a five-year period, providing an unselected real-world dataset that reflects regional surgical practice. However, the limitation of this study is the information bias inherent in its retrospective design. The

reliance on pre-existing medical records may have resulted in incomplete or inconsistently documented data regarding patient comorbidities and intraoperative variables. This limitation restricts a detailed analysis of individual risk factors for flap failure, which in turn limits the interpretation of the findings and their generalizability.

CONCLUSION

The study reaffirms the role of Abdoel Wahab Sjahranie General Hospital as the principal referral center for microsurgery in East Kalimantan. To further improve quality of care and success rates, strengthening postoperative monitoring capacity, expanding non-trauma reconstructive services, optimizing the regional referral network, and implementing preventive strategies tailored to local epidemiology are recommended.

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CONFLICT OF INTEREST

The authors pronounced that there is no conflict of interest.

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This study did not get any funding.

AUTHOR CONTRIBUTION

Designed this study and outlined the draft: DMS. Collected information and performed background literature review: DMS. Data abstraction: DMS and AMA. Review data discrepancies: YA. Supervised results and discussion: DMS, AMA, SSMA, and YA. Performed grammar and writing checks, critical analysis of the data, manuscript revision, and ensured compliance with publication guidelines: DMS, AMA, SSMA, and YA. All authors reviewed and approved the final form of the manuscript.

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