International Journal of Research in Medical Sciences
Roldán LE et al. Int J Res Med Sci. 2026 Mar;14(3):872-876
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20260602

Original Research Article

Intraoperative risk factors associated with the need for reintervention in free flaps: a retrospective study in a third-level referral center in Mexico (2022-2025)

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Received: 02 February 2026
Revised: 14 February 2026
Accepted: 16 February 2026

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ABSTRACT

Background: Free flap surgery is the gold standard for complex reconstruction, yet vascular compromise requiring reintervention remains a significant challenge. This study aims to identify intraoperative risk factors associated with take-back procedures at the Hospital General de México "Dr. Eduardo Liceaga."
Methods: A retrospective comparative study of 121 patients undergoing free flap reconstruction (2022–2025) was conducted. Demographic data, flap types, and intraoperative variables were analyzed. Patients were divided into two groups: Reintervened (n=41) and non-reintervened (n=80). Statistical significance was set at $p<0.05$.
Results: The reintervention rate was 33.8%. The DIEP flap was the most common (26.45%). Younger age was significantly associated with reintervention (32 vs 46 years; p=0.004). The use of intraoperative vein grafts was a major risk factor, present in 29.27% of reintervened cases versus 10% in the successful group (p=0.01). Ischemia time and type of anastomosis did not show statistical significance.
Conclusions: In our population, younger age and the primary need for vein grafts are critical predictors of reintervention. These findings emphasize the need for specialized monitoring protocols for these high-risk subgroups in high-volume Mexican institutions.

Keywords: Free flap, Microsurgery, Reintervention, Vein graft, Mexico, Risk factors

INTRODUCTION

Microvascular free tissue transfer has revolutionized reconstructive surgery, allowing for the salvage of limbs and complex head and neck defects that were previously considered unreconstructable.[1] In Mexico, the Hospital General de México (HGM) stands as a pivotal tertiary center, managing a diverse surgical volume that includes oncological, traumatic, and congenital pathologies.[2] Despite global success rates exceeding 90-95%, surgical reintervention-often termed "take-back"-due to arterial or venous thrombosis remains the most critical complication.[3,4] In the Mexican context, patient characteristics such as uncontrolled comorbidities, nutritional status, and the etiology of the defect (often high-energy trauma in younger populations) may influence these outcomes differently than reported in European or Asian cohorts.[5,6] Current literature from high-impact journals suggests that intraoperative factors, particularly the quality of recipient vessels and the necessity of vein grafts, are more predictive of flap failure than systemic factors.[7,8] This study aims to analyze the experience at HGM over the last three years to identify specific intraoperative variables that predispose to reintervention.

METHODS

Authors conducted a retrospective, observational, analytical study of patients treated at the Plastic and Reconstructive Surgery Department of the Hospital General de México (HGM). Medical records of patients who underwent reconstruction with microvascular free flaps between March 2022 and October 2025 were reviewed.

Inclusion criteria

Patients of any age or sex who underwent reconstruction using microvascular free tissue transfer at the Plastic and Reconstructive Surgery Department of HGM during the study period.

Exclusion criteria

Patients with incomplete medical records or missing critical perioperative data, as well as those who underwent non-vascularized tissue transfers, such as skin grafts or non-vascularized bone grafts.

Data collection

Data were extracted from hospital medical records, as well as surgical and anesthetic logs. Collected variables included age, flap technique, anatomical site, operative time, anesthetic time, ischemia time, type of anastomosis, and use of vein grafts. Operative, anesthetic, and ischemia times were verified using intraoperative records. The presence of vein grafts was obtained from the operative report. Patients were stratified into a reintervened group and a non-reintervened group during follow-up. All data were stored in an electronic spreadsheet for analysis.

Statistical analysis

Statistical analyses were performed using Stata software. For continuous variables, the median and interquartile range were calculated; for categorical variables, absolute frequencies and percentages were reported. Comparisons between patients with and without reintervention were performed using bivariate tests: the Mann–Whitney U test for continuous variables (without assuming normality) and the chi-square or Fisher's exact test for categorical variables. Odds ratios (OR) with 95% confidence intervals were estimated to assess the strength of association between each factor and reintervention. Finally, a multivariable binary logistic regression model was constructed, including variables with $p<0.20$ in the bivariate analysis and adjusting for potential confounders. A p value <0.05 was considered statistically significant.

RESULTS

A total of 121 free flaps were analyzed. The overall reintervention rate was 33.8% (n=41). The most frequently used flap was the DIEP flap (n=32; 26.4%), followed by the anterolateral thigh (ALT) and radial flaps, both with a frequency of 14.9% (Table 1). The median age of the cohort was 45 years. Patients who required reoperation were significantly younger than those with successful flap outcomes (median 32 vs. 46 years; p=0.004). Additionally, the use of a venous graft during the primary procedure was significantly associated with the need for reoperation. This technique was employed in 29.3% of flaps that required reintervention, compared with 10% of successful flaps. In contrast, other intraoperative variables, such as operative time and type of anastomosis, did not show statistically significant differences between groups (Table 2). When comparing flap techniques, no statistically significant association was found between flap type and reoperation rate (p=0.98). However, the data demonstrated a trend suggesting that certain techniques, were associated with a higher percentage of reinterventions. Although these differences did not reach statistical significance, the observed pattern may warrant further investigation in larger cohorts (Table 3).

A multivariable logistic regression analysis including age, operative time, type of anastomosis, venous graft use, and flap technique was performed. The overall model remained statistically significant (LR χ^2 (5) =21.51; p=0.0006), with a pseudo-R^2 of 0.14. Age was independently associated with reoperation (OR 0.96; 95% CI 0.93–0.98; p=0.001), indicating that each additional year of age was associated with an approximately 4% reduction in the odds of reintervention. The use of a venous graft during the primary procedure remained a strong independent predictor of reoperation (OR 6.78; 95% CI 1.95–23.58; p=0.003). In contrast, operative time, type of anastomosis, and flap technique were not significantly associated with reintervention in the adjusted analysis (Table 4).

Table 1: Distribution of free flap techniques.

Flap technique (n=121)	Total (%)
Deep inferior epigastric perforator (DIEP) flap	32 (26.45)
Radial forearm flap	18 (14.88)
Anterolateral thigh (ALT) flap	18 (14.88)
Medial sural artery perforator (MSAP) flap	14 (11.57)
Fibula free flap	8 (6.61)
Latissimus dorsi flap	6 (4.96)
Kite flap	6 (4.96)

Continued.

Flap technique (n=121)	Total (%)
Sural flap	6 (4.96)
Profunda artery perforator (PAP) flap	4 (3.31)
Superficial circumflex iliac artery perforator (SCIP) flap	3 (2.48)
Rectus abdominis flap	2 (1.65)
Lateral arm free flap	1 (0.83)
Inferior epigastric artery flap	1 (0.83)
Medial plantar flap	1 (0.83)
Rectus femoris flap	1 (0.83)

Table 2: Bivariate analysis of factors associated with reoperation.

Variable	Reintervened (n=41)	Non-reintervened (n=80)	P value
Age, years, median (IQR)	32 (20–51)	46 (31–56)	0.004
Operative time, min, median (IQR)	420 (300–600)	420 (340–505)	0.283
Anesthesia time, min, median (IQR)	480 (360–630)	457 (370–585)	0.477
Vascular anastomosis, n (%)			
End to end	34 (82.93)	68 (85)	0.795
End to side	7 (17.07)	12 (15)	
Flap ischemia time, min, median (IQR)	128 (69–180)	120 (73.5–160)	0.896
Vein graft, n (%)	12 (29.27)	8 (10)	0.01

Table 3: Average reinterventions according to flap technique.

Flap technique p=0.98	Reintervened (%)
Deep inferior epigastric perforator (DIEP) flap	8 (33.3)
Radial forearm flap	4 (22.2)
Anterolateral thigh (ALT) flap	9 (50)
Medial sural artery perforator (MSAP) flap	6 (42.8)
Fibula free flap	4 (50)
Latissimus dorsi flap	5 (83.3)
Kite flap	2 (33.3)
Sural flap	0
Profunda artery perforator (PAP) flap	0
Superficial circumflex iliac artery perforator (SCIP) flap	1 (33.3)
Rectus abdominis flap	1 (50%)
Lateral arm free flap	0
Inferior epigastric artery flap	0
Medial plantar flap	0
Rectus femoris flap	1 (100)

Table 4: Multivariable logistic regression analysis of factors associated with reoperation.

Variable	OR	Standard error	IC 95%	P value
Age (per year)	0.96	0.013	0.92-0.98	0.001
Operative time	1.00	0.001	0.99-1.00	0.531
Type of anastomosis	1.28	0.775	0.39-4.19	0.678
Venous graft	6.78	4.311	1.95-23.58	0.003
Flap technique	0.95	0.043	0.87-1.04	0.273

Model performance was further evaluated in terms of calibration and discrimination. The Hosmer–Lemeshow goodness-of-fit test demonstrated adequate calibration (χ^2 (8) =6.11; p=0.635), indicating no evidence of poor model fit. Discriminative ability was assessed using the area under the receiver operating characteristic (ROC) curve, which was 0.73. This value suggests acceptable discrimination, indicating that the model is capable of reasonably distinguishing between flaps that required reoperation and those with successful outcomes (Figure 1).

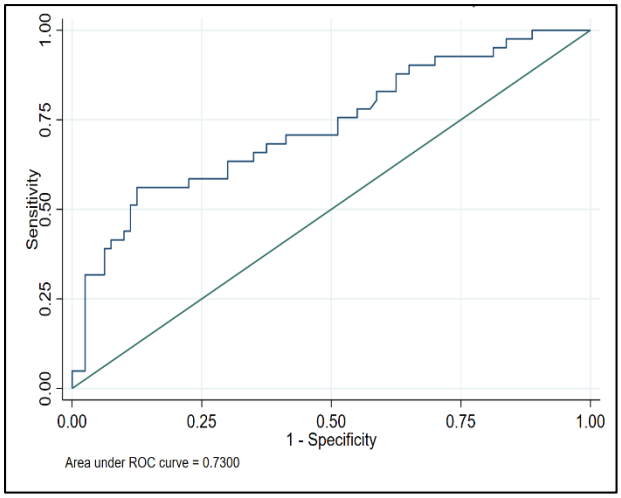

Figure 1: ROC curve of the multivariable model for reoperation risk.

DISCUSSION

The reintervention rate of 33.8% is higher than the 6-15% reported in some international oncological series9,10. However, this reflects the "real-world" complexity of a Mexican public hospital where many cases involve post-traumatic limb salvage and complex wound revisions, which carry a higher inherent risk than elective breast reconstruction.[11] The finding that younger patients (median age 32) are more prone to reintervention is paradoxical but aligns with Mexican epidemiological data: young males are the primary victims of high-energy trauma.[12]

Trauma-induced vascular damage often extends beyond the apparent zone of injury, leading to higher rates of late thrombosis compared to elective oncological cases where vessels are relatively healthy.[13] The protective effect of age, with each additional year reducing the odds of reintervention by approximately 4%, may reflect differences in vascular reactivity and tissue characteristics in younger patients, potentially predisposed to vasospasm or microvascular compromise. It is also possible that certain sociodemographic characteristics are associated with increased postoperative flap care requirements, thereby contributing to a higher need for reintervention, independent of the surgical procedure itself.

The significant correlation between vein grafts and reintervention (p=0.01) confirms that the need for a graft is an indicator of a "hostile" recipient site.[14] The strong association observed with venous graft use likely reflects increased reconstructive complexity rather than a direct causal effect. Venous grafts are typically employed in cases with short pedicles, irradiated or scarred recipient vessels, or complex flap positioning, all of which may inherently increase the risk of flap compromise. These findings highlight the importance of careful intraoperative planning and close postoperative monitoring in these higher-risk scenarios.[13-15] Although no significant association was found between flap technique, operative time, or type of anastomosis and reintervention, the data suggested a trend toward higher reintervention rates in certain flaps. This observation, while not statistically significant, is consistent with previous reports indicating that more technically demanding flaps may be associated with higher early complication rates, Nevertheless, a larger sample size for each reconstructive technique is required to ensure adequate statistical power. This study has limitations that may introduce bias. First, its retrospective design and single-center setting limit the generalizability of the findings. Second, some key variables, such as flap ischemia time, were not consistently recorded, which may have influenced the assessment of intraoperative risk factors. Third, the heterogeneity of flap techniques used, including variations in complexity and anatomical site, may confound the observed associations.

Additionally, certain clinical variables, such as patient comorbidities, smoking status, or prior radiation, were not measured and could act as residual confounders; however, evaluating these factors was beyond the primary scope of this study. Despite these limitations, the analysis provides valuable insight into factors associated with free flap reintervention and establishes a foundation for future prospective, multicentre studies aimed at refining risk stratification and improving surgical outcomes.

CONCLUSION

Intraoperative vein graft use and younger patient age are significant intraoperative predictors for reintervention in our center. This study highlights the importance of identifying high-risk cases intraoperatively to optimize flap salvage through early detection of vascular compromise and to achieve a closer follow up in those cases. The elevated reintervention rate observed in our cohort, compared to international series, is not solely attributable to the demographic profile of young trauma patients. Instead, the requirement for vein grafting serves as a surrogate marker for the complexity of the recipient site. As HGM functions as a tertiary referral center, we frequently manage cases with extensive zones of injury that necessitate microvascular anastomoses performed beyond the zone of trauma. This requirement escalates technical difficulty and increases susceptibility to pedicle thrombosis.

In this study of free flap reconstructions, younger patient age and the use of venous grafts were independently associated with a higher likelihood of reoperation. These factors may reflect underlying vascular characteristics and procedural complexity that warrant careful perioperative planning and monitoring. Although flap technique and other intraoperative variables were not statistically significant, trends toward higher reintervention rates in certain complex flaps suggest the need for heightened vigilance in technically demanding procedures. The multivariable model demonstrated acceptable discrimination and good calibration, supporting its clinical

relevance. Despite the retrospective, single-center design and unmeasured variables such as flap ischemia time and patient comorbidities, these findings provide valuable insight into predictors of free flap complications. They establish a foundation for future prospective studies aimed at refining risk stratification and improving surgical outcomes.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Wei FC, Mardini S. Flaps and Reconstructive Surgery. 2nd ed. Philadelphia, PA: Elsevier. 2016.
2. Cuenca-Pardo J, Ramos-Méndez J, Juárez-López S, Morales-Olivera JM, Iribarren-Moreno R, Contreras-Bulnes L. Reconstrucción microquirúrgica en el Hospital General de México: 10 años de experiencia. Cir Plast. 2010;20(1):6-14.
3. Khouri RK, Cooley BC, Kunselman AR, Landis JR, Yeramian P, Taras J, et al. A prospective study of 22,428 free flap transplantations. Plast Reconstr Surg. 1998;102(3):711-21.
4. Bucio-Duarte JJ, González-Gutiérrez M, Bucio-Sarabia JJ, Bucio-Sarabia ME, Bucio-Sarabia L. Uso de colgajos libres en la reconstrucción de extremidad inferior: experiencia en un hospital de tercer nivel. Cir Plast. 2019;29(1):45-52.
5. Chang DW, Kenworthy P, Miller MJ, Schusterman MA, Reece GP, Robb GL, et al. Analysis of 100 consecutive free flaps in a tertiary center. Plast Reconstr Surg. 2002;109(6):1830-9.
6. Telich-Tarriba JE, Navarro-Navarro SE, Cardenas-Mejia A. Microvascular head and neck reconstruction: experience at a Mexican oncology center. J Reconstr Microsurg Open. 2019;4(1):1-6.
7. Hanasono MM, Butler CE. Predicting outcomes of free flap reconstruction. Plast Reconstr Surg. 2009;124(1):189-98.
8. Godina M. Early microsurgical reconstruction of complex trauma of the extremities. Plast Reconstr Surg. 1986;78(3):285-92.
9. Fischer JP, Nelson JA, Rohrbach JI, Cleveland EC, Kovach SJ, Serletti JM, et al. A multivariate analysis of 416 free flaps: outcomes and predictors. Microsurgery. 2014;34(3):182-90.
10. Lopez-Mendoza J, Garcia-Alvarez J, Ramos-Vazquez M. Reconstrucción mamaria con colgajo DIEP: experiencia inicial en México. Cir Plast. 2014;24(2):80-8.
11. Nelson JA, Fischer JP, Brazio PS, Kovach SJ, Low DW, Kanchwala SK, et al. Intraoperative vein grafts in free tissue transfer: an analysis of 1,000 cases. Plast Reconstr Surg. 2012;129(4):702-10.
12. Lozano-Nuevo JJ, González-Aparicio MA, Rubio-Guerra AF, Serna-Mata JL, Rodríguez-López L, Arana-Pazos JA, et al. Epidemiología de las lesiones por trauma en México. Rev Med Inst Mex Seguro Soc. 2020;58(3):280-9.
13. Hill JB, Vaca EE, Smetona J, Milad S, Dumanian GA, Ko JH. The effect of vein grafts on free flap outcomes: a review of 672 flaps. Ann Plast Surg. 2018;80(6):342-6.
14. Yee-Meléndez ME, Rojas-Molina A, Ortiz-Navarrete C, Cárdenas-Mejía A, Santamaria-Solís E. Microcirugía pediátrica y del adulto joven en el Hospital General de México. Rev Mex Cir Plast. 2021;31(1):12-9.
15. Santamaria E, Orlowsky R, Wei FC. Free flap reconstruction in the head and neck: 25 years' experience at a single institution. Head Neck. 2017;39(12):2436-45.

Cite this article as: Roldán LE, Ramírez ED, Guadarrama DC, Ugalde JA, Riera RF. Intraoperative risk factors associated with the need for reintervention in free flaps: a retrospective study in a third-level referral center in Mexico (2022-2025). Int J Res Med Sci 2026;14:872-6.