

Review

Robotic-Assisted Versus Conventional DIEP Flap Breast Reconstruction: A Critical Review of the Current Literature

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Abstract

Background/Objectives: Robotic-assisted breast reconstruction with deep inferior epigastric perforator (DIEP) flap has been developed as a minimally invasive alternative to conventional open DIEP harvest, having the primary goal of reducing donor-site morbidity while preserving flap reliability. **Methods:** A targeted literature search was performed in PubMed using the keywords “robotic” AND “DIEP”. Following title, abstract and reference screening, 10 studies were included in the final analysis. The current narrative review summarizes the existing literature regarding robotic versus conventional DIEP flap reconstruction, concentrating on abdominal wall preservation, postoperative pain and recovery, operative time, flap survival, and complication rates, with respect to learning curve and feasibility. **Results:** The included studies demonstrate significantly shorter fascial incisions, together with reduced abdominal wall disruption in robotic DIEP harvest compared with conventional techniques. However, current evidence has not demonstrated that this anatomical difference translates into clinically significant reductions in donor-site morbidity. Some comparative studies also report lower postoperative pain scores and shorter hospital stay in robotic cohorts. Flap survival and overall complication rates appear comparable between robotic and conventional DIEP reconstruction. However, robotic surgery remains linked to longer operative times and higher infrastructural requirements. **Conclusions:** Robotic DIEP reconstruction represents a feasible and potentially advantageous evolution in autologous breast reconstruction, but larger prospective multicenter studies with long-term follow-up are necessary to establish definitive superiority over conventional techniques.

Keywords: robotic DIEP; breast reconstruction; microsurgery; perforator flap; donor-site morbidity; minimally invasive surgery

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1. Introduction

Autologous breast reconstruction using the deep inferior epigastric perforator (DIEP) flap is globally considered one of the most effective options of reconstruction following mastectomy, because it provides natural breast volume along with preserving the rectus abdominis muscle [1]. In comparison with muscle-sacrificing techniques like the transverse rectus abdominis myocutaneous (TRAM) flap, conventional DIEP reconstruction decreases donor-site morbidity and better preserves the function of the abdominal wall [1,2]. Furthermore, standard open DIEP flap harvest requires a substantial anterior rectus sheath incision and varying degrees of intramuscular pedicle dissection [2–4], which might cause postoperative pain, abdominal weakness, bulge formation and even development of hernia [5–7].

In recent years, robotic-assisted surgery has gained popularity in reconstructive microsurgery and breast reconstruction [5]. Robotic DIEP flap harvest was developed with the aim of further minimizing abdominal wall trauma. It allows the dissection of the intracorporeal pedicle by performing significantly smaller fascial incisions [6,7]. When using robotic platforms like the da Vinci system (da Vinci Surgical System, Intuitive Surgical, Sunnyvale, CA, USA), surgeons might follow the deep inferior epigastric vessels from an intraperitoneal or extraperitoneal point of view, with limited disruption of the rectus muscle and fascial envelope [7,8].

The list of theoretical advantages of robotic DIEP reconstruction includes decreased postoperative pain, lower perioperative consumption of opioid drugs, faster recovery, shorter duration of hospitalization and decreased long-term morbidity of the donor site [1,8]. However, robotic surgery also has a few drawbacks, such as increased operative time, elevated equipment costs, the need for dedicated training and a potentially steep learning curve [5]. Moreover, the existing body of evidence remains based on case reports, case series, retrospective studies and several studies with relatively small cohorts performed in highly specialized centers.

As the evolution of robotic breast reconstruction is continuous, an evidence-based review of current outcomes is necessary to clarify its clinical pros and cons (compared with conventional open DIEP surgery). Hence, the purpose of this review is to summarize and critically analyze the available literature on robotic versus conventional DIEP flap reconstruction, with emphasis on perioperative outcomes, complication profiles, donor-site morbidity, technical approaches, learning curves and future perspectives.

2. Materials and Methods

The flowchart in Figure 1 summarizes the literature search and article selection process used to identify studies included in this narrative review. The evaluated outcomes consisted of fascial incision length, donor-site morbidity, postoperative pain, opioid consumption, length of hospital stay, operative time, flap survival rate, complication rates, and learning curve feasibility.

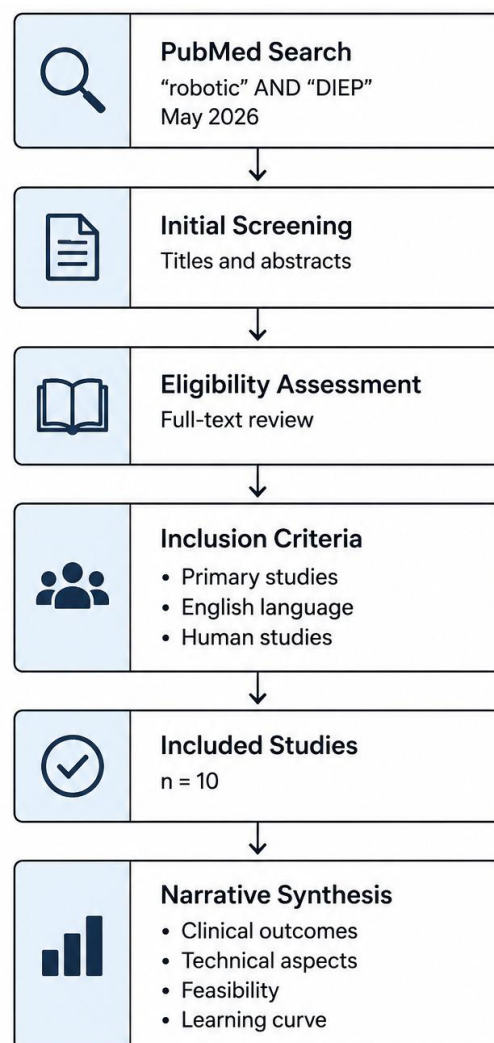


Figure 1. Overview of the literature search and study selection process for this narrative review.

2.1. Study Design and Literature Search Strategy

The current study represents an evidence-based narrative review of the published literature, focusing on robotic-assisted versus conventional DIEP flap breast reconstruction. A systematic review methodology according to PRISMA guidelines was not applied, as the objective of this manuscript was to provide an exploratory synthesis of an emerging and heterogeneous field rather than a formal systematic evidence assessment. However, a targeted search strategy was implemented to minimize selection bias.

A targeted literature search was performed in May 2026 in the PubMed database to find studies that evaluate robotic-assisted DIEP flap breast reconstruction. The search strategy that was used included the following PubMed query: ("robotic" [Title/Abstract]) AND ("DIEP" [Title/Abstract]).

The literature search identified studies published in English evaluating robotic-assisted DIEP flap harvest and breast reconstruction outcomes. An additional filter was "species = Humans".

The reference lists of all eligible articles were manually reviewed to further identify relevant publications which were not captured during the initial search in the database.

2.2. Eligibility Criteria

Only primary studies were included in the present review. Study designs included:

- Cohort studies;

- Retrospective studies;
- Case reports and case series;
- Technical reports;
- Cadaveric feasibility studies.

Studies without primary clinical data (systematic reviews, meta-analyses, narrative reviews, editorials and conference abstracts) were excluded from the final analysis.

Following title and abstract screening with full-text review of potentially relevant articles, 10 primary studies were included for narrative synthesis. Given the novelty of robotic DIEP reconstruction, the available literature consisted of a limited number of eligible primary studies.

2.3. Outcomes of Interest

The primary outcomes evaluated included:

- Fascial incision length;
- Donor-site morbidity;
- Postoperative pain;
- Opioid consumption;
- Length of hospital stay;
- Operative time;
- Flap survival rate;
- Complication rates;
- Learning curve and feasibility.

2.4. Evidence Synthesis

Given the narrative review design, no formal meta-analysis, risk-of-bias assessment, or quantitative evidence grading was performed. Due to the heterogeneity of study designs, surgical techniques and outcome reporting systems, findings were synthesized qualitatively, emphasizing consistency of observations across available studies.

3. Results

3.1. Overview of Analyzed Studies

Some papers originated from overlapping institutional robotic DIEP cohorts but assessed distinct outcomes, including comparative perioperative outcomes, technical implementation and learning-curve analysis.

Current evidence regarding robotic DIEP reconstruction consists primarily of retrospective cohort studies, controlled comparative studies, case series, and reports originating from specialized reconstructive centers (Tables 1 and 2).

Table 1. Comparative clinical studies on robotic versus conventional DIEP flap reconstruction.

Study	Design	Population	Comparison	Primary Outcomes	Key Findings
Lee et al. [1], 2022	Retrospective matched cohort	207 patients (21 robotic, 186 conventional)	Robotic vs. conventional DIEP	Pain, opioids, LOS, BREAST-Q, complications	Robotic group had lower early pain, reduced opioid use, shorter LOS and improved BREAST-Q abdominal well-being; longer operative time
Moreira et al. [2], 2025	Retrospective comparative cohort	47 patients (23 robotic, 24 conventional)	Robotic bilateral DIEP vs. conventional DIEP	Fascial incision, mesh use, OR time, LOS, complications	Significantly shorter fascial incision (4.1 vs. 11.7 cm), no mesh use in robotic

					group, similar complications, longer OR time
Tsai et al. [3], 2023	Retrospective controlled cohort	100 patients (13 robotic, 87 conventional)	RA-DIEP vs. conventional DIEP	Fascial incision, pain, complications	Significantly reduced fascial incision (2.67 vs. 8.14 cm), lower (non-significant) pain trend, no donor-site complications in robotic group
McCreery et al. [8], 2025	Retrospective cohort	14 robotic vs. 40 controls	Robotic DIEP vs. abdominal free flaps	Pain, opioids, antiemetics	Lower pain scores, reduced opioid consumption and antiemetic use in robotic group

RA-DIEP = robotic-assisted deep inferior epigastric perforator flap; DIEP = deep inferior epigastric perforator flap; OR = operating room; LOS = length of hospital stay; BREAST-Q = validated patient-reported outcome measure for breast reconstruction.

Table 2. Non-comparative, technical, feasibility and learning-curve studies.

Study	Design	Population	Focus	Key Findings
Wittesaele & Vandevooort [4], 2022	Case series	10 patients	Clinical feasibility	Safe implementation; no flap loss or major complications
Daar et al. [5], 2022	Case series	4 patients/7 flaps	Robotic DIEP feasibility	No flap failure; no donor-site morbidity; adequate pedicle length
Murariu et al. [6], 2025	Technical clinical series	23 patients/46 flaps	Bilateral robotic DIEP technique	Mean pedicle ~12.8 cm; no major complications; reproducible technique
Kuo et al. [7], 2025	Clinical series	14 patients	OPERA (robotic mastectomy + DIEP)	100% flap survival; minimal fascial incision; no late bulge/hernia
Manrique et al. [9], 2020	Cadaveric feasibility study	16 hemi-abdomens	TAPP vs. TEP robotic DIEP	Both approaches feasible; TEP reduced bowel manipulation; technical validation
Moreira et al. [10], 2024	Learning curve analysis	44 dissections	Surgical learning curve	Proficiency achieved after ~9–10 cases; improved operative efficiency

DIEP = deep inferior epigastric perforator flap; TAPP = trans-abdominal preperitoneal approach; TEP = totally extraperitoneal approach; OPERA = oncological entirely robot-assisted approach.

The largest comparative analysis was conducted by Lee et al., who evaluated in their study 207 patients who underwent either robotic or conventional DIEP reconstruction using inverse probability weighting [1].

Additional comparative cohorts were reported by Moreira et al. and Tsai et al., which focused on bilateral robotic DIEP harvest and novel robotic approaches [2,3].

Several robotic-only implementation and feasibility series further assessed perioperative outcomes, donor-site morbidity, and technical reproducibility [4–7].

Technical aspects of robotic DIEP harvest varied between the included studies (Table 3). In the selected studies, da Vinci Xi robotic platform (Intuitive Surgical, Sunnyvale, CA, USA) was used, with trans-abdominal preperitoneal (TAPP) access representing the most frequently reported approach [2–8]. In contrast, Lee et al. implemented a totally extraperitoneal (TEP) technique, aiming to minimize intra-abdominal manipulation [1]. Bilateral robotic DIEP harvest was primarily described in the studies of Moreira et al. and Murariu et al. [2,6], while Kuo et al. reported a fully robotic OPERA approach combining robot-assisted mastectomy with unilateral robotic DIEP reconstruction [7]. In addition, Tsai et al. proposed a novel port placement configuration intended to improve bilateral pedicle access and operative visualization [3]. On the whole, despite technical heterogeneity

among studies, robotic-assisted pedicle dissection proved feasible and reproducible across different surgical strategies and reconstructive settings.

Table 3. Technical characteristics of robotic DIEP studies.

Study	Approach	TAPP/TEP	Unilateral/Bilateral
Lee et al. [1]	Robotic pedicle harvest	TEP	Mixed
Moreira et al. [2]	Multiport robotic harvest	TAPP	Bilateral
Tsai et al. [3]	Novel port placement	TAPP	Mixed
Wittesaele et al. [4]	Multiport robotic harvest	TAPP	Mixed
Daar et al. [5]	Intraperitoneal robotic harvest	TAPP	Mixed
Kuo et al. [7]	Fully robotic OPERA	TAPP	Unilateral

TAPP = trans-abdominal preperitoneal; TEP = totally extraperitoneal; DIEP = deep inferior epigastric.

3.2. Fascial Incision Length and Abdominal Wall Preservation

Reduction in fascial incision length was the most consistent finding across several studies on robotic DIEP (Table 4).

Table 4. Perioperative outcomes in robotic versus conventional DIEP flap reconstruction.

Study	Outcome	Robotic DIEP	Conventional DIEP	Notes
Lee et al. [1]	Operative time	Longer	Shorter	Significant increase in robotic group
Lee et al. [1]	Hospital stay	Shorter	Longer	Significant reduction in robotic group
Moreira et al. [2]	Fascial incision	4.1 cm	11.7 cm	$p < 0.001$
Moreira et al. [2]	Mesh use	0%	54%	Significant difference
Tsai et al. [3]	Fascial incision	2.67 cm	8.14 cm	$p < 0.0001$
Daar et al. [5]	Pedicle length	11.2 cm	Not applicable	Case series
Murariu et al. [6]	Pedicle length	12.8 cm	Not reported	Robotic series
Kuo et al. [7]	Fascial incision	2.6 cm	Not reported	Robotic series only

In their work, Moreira et al. demonstrated an average fascial incision length of 4.1 cm in robotic bilateral DIEP harvest in comparison with 11.7 cm in conventional surgery ($p < 0.001$) [2].

Likewise, Tsai et al. reported significantly smaller anterior rectus sheath incisions in the robotic-assisted procedures (2.67 ± 1.13 cm versus 8.14 ± 1.69 cm, $p < 0.0001$) [3].

In the OPERA study, Kuo et al. described mean fascial incisions of only 2.6 ± 0.9 cm [7].

Reduced fascial incision size did not appear to affect pedicle length or flap perfusion. Reported robotic pedicle lengths ranged from approximately 10.3 to 12.8 cm and they remained equivalent to conventional DIEP surgery [2,5–7].

The study of Moreira et al. reported no utilization of mesh in robotic bilateral DIEP reconstruction, while mesh was required in 54% of conventional procedures [2].

3.3. Postoperative Pain and Recovery Process

Some studies reported improved early postoperative recovery following the robotic DIEP reconstruction (Table 5).

Table 5. Postoperative pain, opioid use and recovery outcomes.

Study	Outcome	Robotic DIEP	Control	Notes
Lee et al. [1]	Early postoperative pain	Lower (6–24 h)	Higher	Significant reduction
Lee et al. [1]	Opioid use	Lower fentanyl use	Higher	Significant reduction
Lee et al. [1]	BREAST-Q abdominal well-being	Higher	Lower	Significant improvement
McCreery et al. [8]	Pain scores POD1–3	Lower	Higher	Significant difference
McCreery et al. [8]	OME consumption	Lower	Higher	Significant reduction
McCreery et al. [8]	Antiemetic use	Lower	Higher	Significant reduction

DIEP = deep inferior epigastric perforator flap; POD = postoperative day; OME = oral morphine equivalents; BREAST-Q = validated patient-reported outcome measure for breast reconstruction.

Lee et al. reported significantly lower postoperative pain scores and reduced opioid (fentanyl) rescue requirements in the first 24 postoperative hours in patients who underwent robotic-assisted DIEP flap breast reconstruction [1]. Additionally, patients who underwent robotic reconstruction reported improved BREAST-Q abdominal physical well-being scores [1].

McCreery et al. assessed postoperative pain, together with narcotic consumption in robotic DIEP patients compared to abdominal free-flap controls [8]. The robotic cohort reported significantly lower pain scores during postoperative days 1–3, combined with lower oral morphine equivalent consumption and reduced utilization of antiemetic drugs [8].

Another smaller series study described rapid mobilization, with lower analgesic requirements and improved early abdominal comfort following the robotic intervention [4].

3.4. Length of Hospital Stay

Most comparative studies reported shorter hospitalization following the robotic DIEP reconstruction [1,2,8].

In their study, Lee et al. observed significantly shorter hospital stay in the group of robotic patients compared with the conventional DIEP reconstructive technique [1].

In addition, the robotic reconstruction cohorts reported by Murariu et al. and McCreery et al. reported hospitalizations ranging between approximately 3.9 and 4.9 days [6,8].

Even though Moreira et al. identified only a non-significant trend toward shorter hospitalization in the robotic group, other sources suggested enhanced postoperative recovery following robotic harvest [2].

3.5. Operative Time

Robotic DIEP reconstruction was consistently linked to increased operative time, mostly during the early implementation phases [1,2].

The study of Lee et al. reported significantly prolonged reconstruction time in robotic procedures [1]. The same findings were described by Moreira et al., reporting total operative times of 739 min in robotic bilateral DIEP surgery in comparison with 630 min in conventional open reconstruction [2].

The reported robotic pedicle dissection and console times varied substantially between studies, ranging from 53 to 139 min (the authors acknowledging the importance of surgical technique and institutional experience) [3,4,6].

Learning-curve analyses highlighted progressive improvements with experience. Moreira et al. showed that operative efficiency improved substantially after approximately 9–10 robotic harvest interventions [10].

3.6. Flap Survival and Complication Rates

Perioperative and postoperative safety outcomes, including intraoperative events, donor-site morbidity and early postoperative complications, are summarized in Table 6.

Table 6. Reported perioperative and postoperative outcomes in robotic DIEP flap studies.

Study	Outcome Type	Reported Findings
Lee et al. [1]	Flap-related outcomes	No significant difference in overall complication rates between robotic and conventional DIEP; no increase in major complications
Moreira et al. [2]	Intraoperative + early post-operative outcomes	No intraoperative pedicle injuries reported; similar complication profile between groups
Tsai et al. [3]	Donor-site outcomes	No donor-site complications reported in robotic group during study period
Wittesaele & Vandevoort [4]	Feasibility outcomes	No flap loss or major intra-abdominal complications reported
Daar et al. [5]	Donor-site outcomes	No abdominal wall morbidity reported during follow-up (~6 months)
Murariu et al. [6]	Intraoperative outcomes	No pedicle injuries or intra-abdominal complications reported
Kuo et al. [7]	Long-term outcomes	No abdominal bulge or hernia reported at mean follow-up (~19 months)

Current evidence indicates that robotic DIEP reconstruction maintains flap safety in comparison to conventional surgery [1–7].

Across the published robotic cohorts, complete flap loss was very rare and most of the series reported no total flap failures [2,4–7]. Lee et al. found no statistically significant increase in postoperative complications in the group of robotic patients compared with the group of conventional DIEP flap reconstruction [1].

Moreira et al. additionally reported no events of intraoperative pedicle injury, as well as no intra-abdominal complications in robotic bilateral DIEP harvest [2]. Similarly, Wittesaele and Vandevoort observed neither flap loss nor bowel injuries following robotic implementation [4].

Donor-site complications also appeared with low incidence. No abdominal bulges or hernias were reported during the follow-up periods extending up to approximately 19 months in several robotic cohort studies [5–7,10].

3.7. Learning Curve and Technical Feasibility

The findings related to learning curves and technical feasibility were represented in Table 7.

Table 7. Technical and learning-curve outcomes.

Study	Parameter	Result
Manrique et al. [9]	TAPP vs. TEP time	TAPP faster
Manrique et al. [9]	Bowel manipulation	Higher in TAPP
Manrique et al. [9]	Feasibility	Both techniques feasible
Moreira et al. [10]	Learning curve	Proficiency at ~9–10 cases
Moreira et al. [10]	Pedicle dissection efficiency	Improved after learning curve

TAPP = trans-abdominal preperitoneal approach; TEP = totally extraperitoneal approach.

Robotic DIEP reconstruction demonstrated a measurable and achievable learning curve [10].

Moreira et al. analyzed 44 robotic pedicle dissections and reported proficiency level after approximately 9–10 procedures [10]. The authors also mentioned that operative efficiency improved progressively following the initial implementation phase [10].

Technical feasibility was consistently proven across both unilateral and bilateral reconstructions [2,4–7]. However, robotic interventions required specialized infrastructure, multidisciplinary collaboration and advanced expertise in robotic surgery [2,6].

A cadaveric study comparing TAPP and TEP approaches showed that both techniques were feasible, even if TEP reduced the manipulation of the bowel (and at the same time, remaining technically more demanding) [9].

4. Discussion

4.1. Overview of the Main Findings of the Analyzed Studies

Although robotic-assisted DIEP reconstruction has demonstrated several promising perioperative findings, the currently available evidence does not establish its superiority over conventional DIEP reconstruction. Most published studies are retrospective, include relatively small patient cohorts, and derive from highly specialized centers, limiting both the strength and generalizability of the available evidence. Consequently, the reported advantages must be interpreted as preliminary observations rather than definitive clinical benefits.

Robotic-assisted DIEP flap reconstruction remains one of the most significant recent developments in fields like autologous breast reconstruction and minimally invasive microsurgery. The main objective of robotic DIEP harvest is the reduction in abdominal wall morbidity and this is achieved by minimizing both the size of fascial incision and intramuscular dissection [2,6].

The most consistently reported finding (within the limited available evidence) is the reduction in anterior rectus sheath incision length that is achieved with robotic surgery [2,3]. Some independent comparative studies reported fascial incisions being equal to approximately one-third the size of those that are required in conventional open DIEP harvest [2,3]. Although fascial incision length is consistently reduced with robotic harvest, current evidence has not yet demonstrated that this anatomical difference translates into clinically significant reductions in objective donor-site morbidity, such as abdominal wall weakness, bulge formation or hernia. Therefore, smaller fascial incisions should not be interpreted as direct evidence of reduced abdominal wall morbidity or improved long-term functional outcomes.

Smaller fascial incisions did not appear to compromise reconstructive reliability. Robotic cohorts achieved adequate pedicle lengths and good flap survival rates [2,5–7]. Current evidence suggests that robotic surgery might simultaneously preserve both vascular safety and donor-site integrity.

Another major advantage which is associated with robotic DIEP reconstruction is represented by the improved postoperative recovery. Multiple studies showed lower pain scores, together with reduced opioid consumption and reduced antiemetic requirements after robotic-assisted DIEP breast reconstruction [1,8]. These findings are biologically plausible considering the reduced degree of fascial and muscular disruption. However, pain remains an inherently subjective outcome that is influenced by multiple factors. Consequently, although these findings are encouraging, they should be regarded cautiously until confirmed by larger prospective studies using standardized postoperative care protocols. The improved postoperative recovery might, in addition, facilitate earlier mobilization and shorter hospitalization [1,2].

Despite all these advantages, robotic DIEP reconstruction technique has some important limitations. The most consistent disadvantage which was identified across the included studies was the prolonged operative duration [1,2]. It is well-known that robotic

surgery requires additional setups, docking and intracorporeal dissection time, mostly during early adoption phases. However, one learning-curve analysis suggested that the operative efficiency can improve significantly with increasing experience [10].

Long-term donor-site outcomes are incompletely understood. Even though no abdominal bulges or hernias were reported in multiple robotic series, these complications could develop years following the surgical intervention [5–7]. Follow-up durations were relatively short, and patient cohorts were limited in size. Consequently, any potential reduction in long-term abdominal wall morbidity should be regarded as hypothetical until confirmed by adequately powered comparative studies with prolonged follow-up. Larger studies, designed prospectively, with long-term functional assessment are necessary before drawing definitive conclusions on abdominal wall superiority.

Robotic DIEP surgery marks a natural progression in the refinement of perforator flaps, aiming for maximal preservation of the abdominal wall. Several alternative minimally invasive techniques have been developed in order to reduce donor-site morbidity [9]. However, some non-robotic approaches could compromise pedicle length or increase fat necrosis rates [9].

4.2. Limitations of the Current Review

The present review has several methodological limitations. As a narrative review, it was not designed according to PRISMA systematic review methodology and therefore did not include protocol registration, formal risk-of-bias assessment, or quantitative synthesis. Furthermore, the literature search was limited to PubMed, which may have resulted in omission of potentially relevant studies indexed exclusively in other databases. However, this approach was selected considering the exploratory aim of the review and the limited number and heterogeneous nature of available primary studies regarding robotic DIEP reconstruction.

Other limitations of the present review are related to inherent limitations related to the retrospective nature of the included studies and the predominance of small, single-institution series. In addition, a single-database search (PubMed) might have introduced selection bias. Publication bias is likely, considering the predominance of small case series originating from high-volume tertiary centers, which might likely report positive (or technically successful) outcomes. The absence of PRISMA methodology is due to the exploratory nature of the topic and the limited number of available primary studies.

Another important limitation is attributed to the quality of the available evidence. The included studies were retrospective and predominantly derived from high-volume, specialized centers, so limited generalizability represents an important concern. Thus, the reported outcomes may not be reproducible in lower-volume institutions, limiting the external validity of the available evidence. The robotic cohorts were relatively small, with the respective follow-up periods being frequently shorter than two years. Furthermore, none of the currently available comparative studies are randomized, and patient selection bias cannot be excluded.

4.3. Evidence Synthesis, Study Rationale and Future Perspectives

In the current literature, secondary studies (like systematic reviews and meta-analyses) can also be identified [11–15]. However, the current evidence base is limited and relies on a small number of heterogeneous primary studies. This gap in comparative evidence justifies the present focused synthesis of primary clinical studies focusing on robotic and conventional DIEP flap reconstruction, comparatively.

The current level of evidence supporting robotic DIEP reconstruction remains heterogeneous. A structured summary of the principal clinical claims and corresponding strength of evidence is presented in Table 8. Evidence strength was assigned relying on

study design, consistency of findings and sample size (without application of a formal grading system).

Table 8. Summary of evidence strength for robotic DIEP claims.

Claim	Evidence Strength	Reasoning	Citations
Robotic DIEP reduces fascial incision length versus conventional DIEP	Moderate-to-strong	Consistent, clinically significant reduction in fascial incision length across multiple comparative cohorts, while maintaining adequate pedicle length and flap viability	[2,3,6,7]
Robotic DIEP improves early pain and recovery (opioids, LOS)	Moderate	Retrospective matched and controlled studies demonstrated lower postoperative pain scores, reduced opioid requirements and shorter hospitalization, although evidence remains limited by retrospective design and moderate cohort size	[1,8]
Robotic DIEP demonstrates similar major complication and flap loss rates compared with conventional DIEP	Moderate	Multiple cohort studies and clinical series reported comparable complication profiles and extremely low flap loss rates, although robotic cohorts remain relatively small	[1–8]
Robotic DIEP may reduce long-term abdominal wall morbidity (hernia/bulge formation)	Weak	Theoretical and early clinical advantages exist due to smaller fascial incisions and reduced abdominal wall disruption; however, long-term follow-up and large prospective studies are lacking	[2,5–7]

DIEP = deep inferior epigastric perforator; LOS = length of stay.

Future technological advances will most likely improve even more the technique of robotic breast reconstruction. Advances concerning robotic platforms, single-port systems and even artificial intelligence-assisted navigation systems could reduce operative complexity and improve surgical precision at some point in the future. In addition, increasing the institutional experience with the development of specialized teams could be one solution to optimize the broader adoption of robotic reconstructive surgery.

Future investigations should prioritize objective and clinically meaningful endpoints, including abdominal hernia and bulge rates, donor-site functional outcomes, reoperation rates, complication profiles, quality-adjusted recovery, and even cost-effectiveness analyses. Demonstration of significant improvements with respect to these objective outcomes will be essential to justify the increased operative time, infrastructure requirements and financial costs associated with robotic-assisted DIEP reconstruction.

5. Conclusions

Robotic-assisted DIEP flap breast reconstruction is a feasible and increasingly reproducible minimally invasive alternative to conventional open DIEP surgical technique. Current evidence demonstrates significantly smaller fascial incisions, with reduced abdominal wall disruption compared to conventional techniques. However, whether this anatomical difference translates into clinically meaningful reductions in abdominal wall morbidity remains uncertain because long-term comparative evidence is limited.

Available comparative studies suggest improved early postoperative recovery, characterized by lower pain scores, reduced analgesic requirements and shorter hospitalization; however, these findings should be interpreted cautiously because the current evidence is predominantly retrospective and based on relatively small cohorts. Another important claim is that robotic surgery appears to be capable of maintaining the safety of flaps and the reconstructive reliability comparable to conventional DIEP reconstruction.

However, robotic DIEP reconstruction remains associated with longer operative times, increased infrastructural demands, substantial financial costs and a significant learning curve. Furthermore, current evidence remains limited by retrospective study design, relatively small sample sizes and modest follow-up duration.

Even if early donor-site outcomes are promising, definitive evidence regarding long-term reduction in abdominal wall morbidity is missing. Larger prospective multicenter studies with standardized long-term functional outcomes and also studies with cost-effectiveness analyses are necessary to establish the definitive role of robotic DIEP reconstruction in the modern practice of breast reconstruction.

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